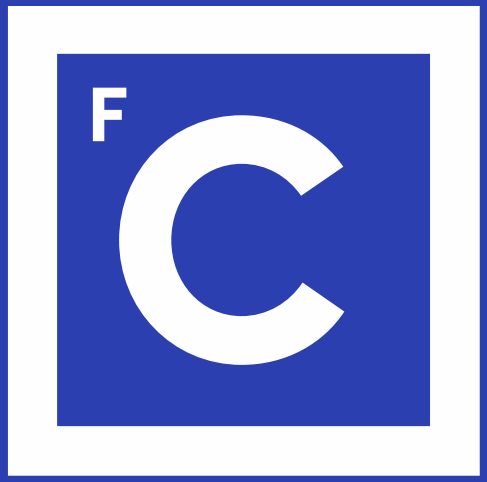

Ciências ULisboa

Faculdade
de Ciências
da Universidade
de Lisboa

Eng. Energy & Environment

Sustainable Mobility

Information

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Transport related SDG

MAKE CITIES AND HUMAN SETTLEMENTS INCLUSIVE, SAFE, RESILIENT AND SUSTAINABLE

Challenge

Mobility and the SDGs: A safe, affordable, accessible and sustainable transport system for all

UITP ADVANCING PUBLIC TRANSPORT

Challenge

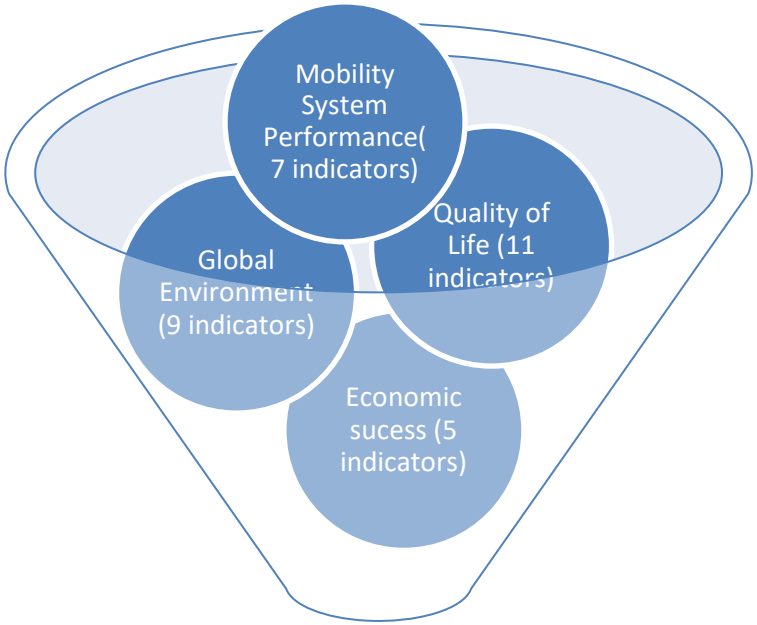
CHALLENDGE

Is Lisbon mobility more sustainable than other metropolitan region mobility?

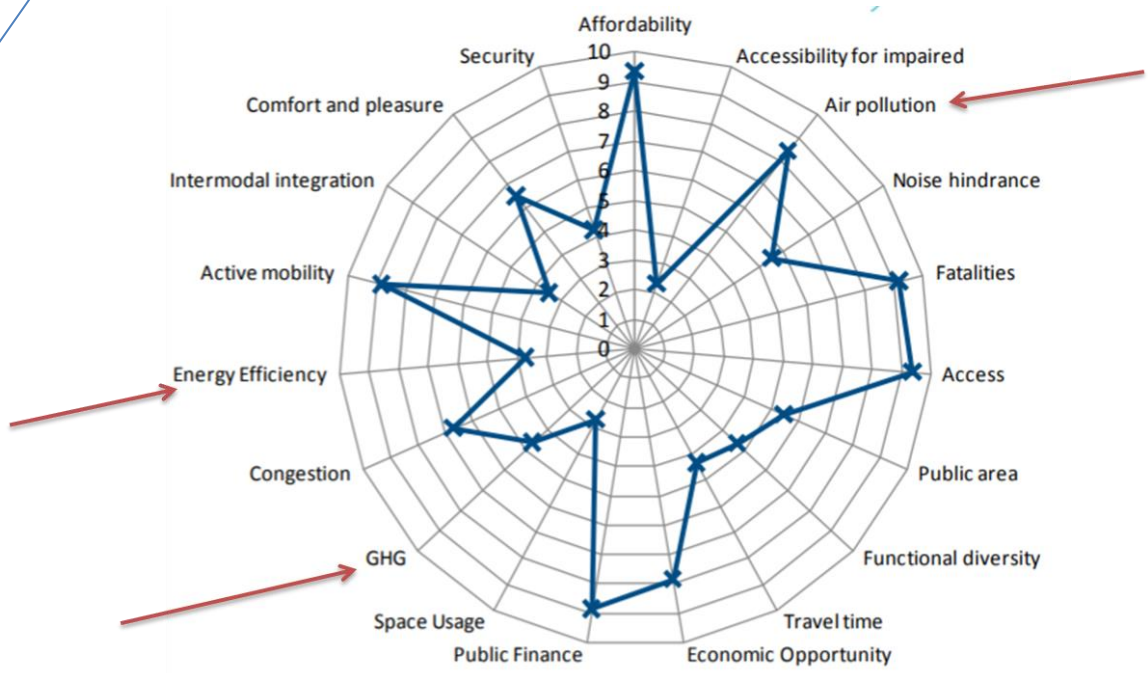
Commuting duration

Waste fuel ↓ **Waste time** ↓ Quality of life/ €

MODULE #2 - Energy efficiency and emissions



Radar graph



MODULE #2 - Energy efficiency and emissions

MONITOR

Energy efficiency

DATA.....DATA.....DATA....
DATA.....DATA.....DATA....
DATA.....DATA.....DATA....

Transportation vehicles

- **Can be classified by:**

✓ Modes;

✓ Function;

✓ Geographical coverage;

✓ Ownership;

✓ Automation level;

✓ Tecnhology;

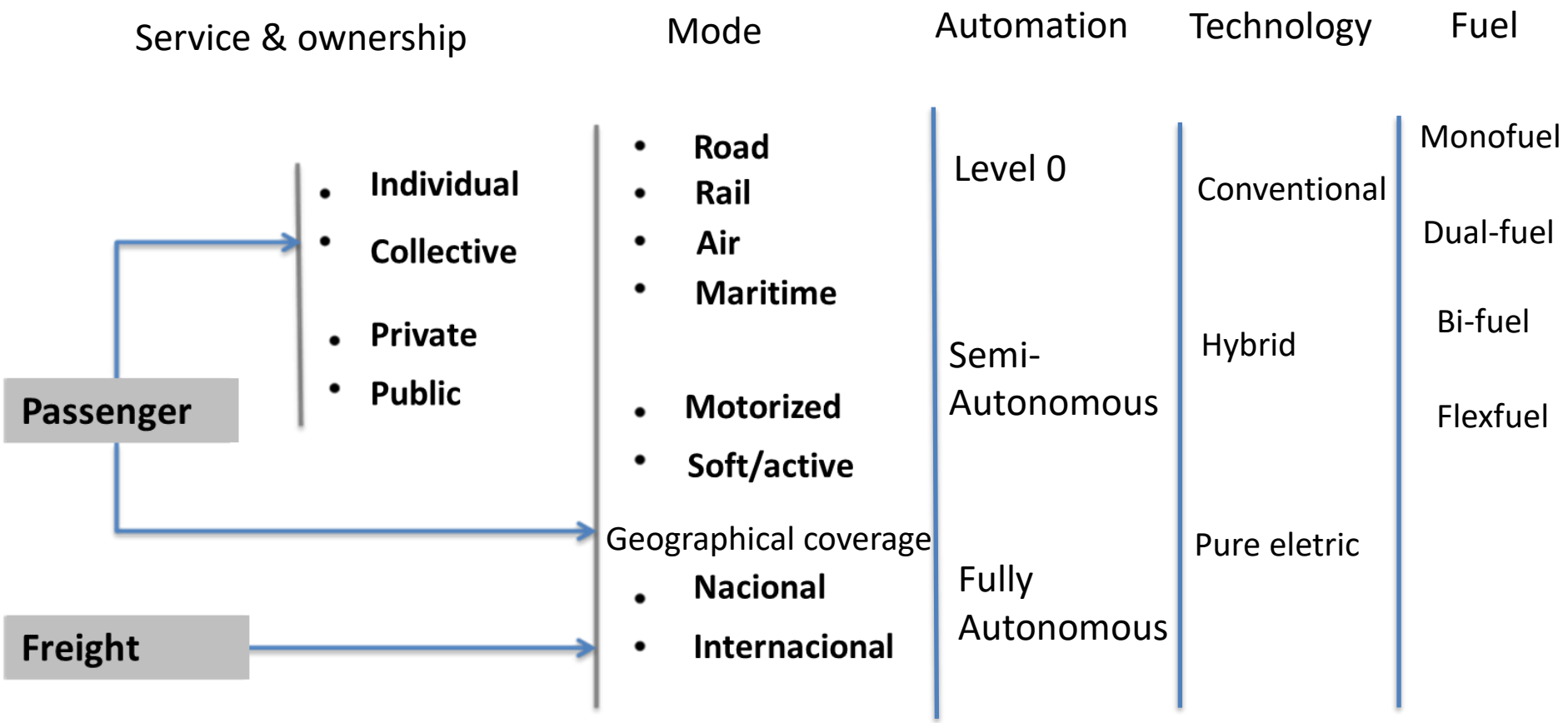
✓ Fuel/energy source;

✓ Eletric vehicles;

✓ Biofuels;

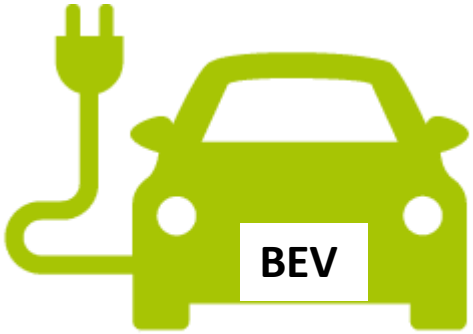
✓ Emission standard.

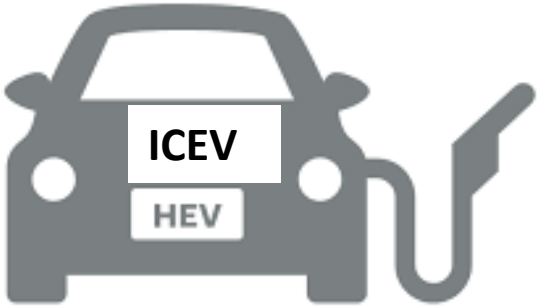
CLASSIFICATION OF TRANSPORTS



TRANSPORTATION BY TECNHOLOGY

- Pure electric (battery EV)
- Plug-in Hybrid (PHEV)
- Hybrid (HEV)
- Conventional (ICEV)





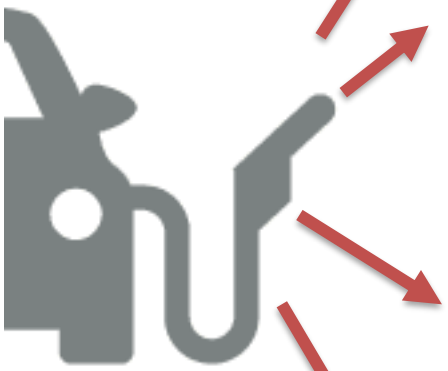
TRANSPORTATION BY TECNHOLOGY

Período de referência dos dados	Localização geográfica	Tipo de veículo (1)	Veículos rodoviários motorizados (N.º) por Tipo de veículo e Tipo de combustível; Anual (2)								
			Tipo de combustível								
			Total	Gasóleo	Gasolina	GPL	Biodiesel	Elétrico puro	Elétrico híbrido plug-in	Elétrico híbrido não plug-in	Outros
			N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º
2020	Portugal	Total	8 349 381	4 616 541	3 543 690	59 445	x	33 749	31 007	61 415	3 534
		Ciclomotores, motociclos, triciclos e quadriciclos	1 328 269	29 993	1 290 844	44	x	5 461	17	43	1 867
		Ciclomotores	584 554	2 715	577 425	37	x	2 467	13	40	1 857
		Motociclos	648 051	87	646 719	3	x	1 235	-	3	4
		Triciclos e quadriciclos	95 664	27 191	66 700	4	x	1 759	4	-	6
		Ligeiros	6 888 903	4 455 538	2 252 823	59 366	x	28 191	30 990	61 324	671
		Passageiros	5 565 963	3 146 222	2 241 224	58 717	x	26 949	30 990	61 308	553
2019	Portugal	Total	8 312 469 *	4 630 570	3 529 717	58 354	x	24 090	17 543	48 893	3 302 *
		Ciclomotores, motociclos, triciclos e quadriciclos	1 284 870	29 692	1 248 351	44	x	4 860	17	45	1 861
		Ciclomotores	576 907	2 764	569 993	38	x	2 206	13	42	1 851
		Motociclos	613 377	88	612 295	3	x	984	-	3	4
		Triciclos e quadriciclos	94 586	26 840	66 063	3	x	1 670	4	-	6
		Ligeiros	6 880 725	4 455 127	2 281 311	58 253	x	19 144	17 526	48 794	570
		Passageiros	5 452 119	3 044 926	2 264 850	57 432	x	18 139	17 526	48 787	459
2018	Portugal	Total	7 940 894	4 389 665	3 430 293	56 975	x	14 267	9 716	37 038	2 940
		Ciclomotores, motociclos, triciclos e quadriciclos	1 235 563	29 323	1 200 656	41	x	3 639	17	43	1 844
		Ciclomotores	565 051	2 817	558 714	35	x	1 598	13	40	1 834
		Motociclos	577 185	89	576 572	3	x	514	-	3	4
		Triciclos e quadriciclos	93 327	26 417	65 370	3	x	1 527	4	-	6
		Ligeiros	6 576 883	4 232 739	2 229 599	56 878	x	10 580	9 699	36 962	426
		Passageiros	5 282 970	2 952 260	2 217 506	56 213	x	9 980	9 699	36 960	352
2017	Portugal	Total	7 632 238	4 202 852	3 334 624	53 064	x	7 938	4 611	28 246	903
		Ciclomotores, motociclos, triciclos e quadriciclos	1 184 997	28 872	1 152 952	38	x	2 877	17	40	201
		Ciclomotores	549 653	2 877	545 434	32	x	1 062	13	37	198
		Motociclos	544 569	88	544 003	3	x	469	-	3	3
		Triciclos e quadriciclos	90 775	25 907	63 515	3	x	1 346	4	-	-
		Ligeiros	6 325 855	4 053 217	2 181 634	52 969	x	5 050	4 594	28 177	214
		Passageiros	5 059 472	2 800 640	2 168 924	52 315	x	4 667	4 594	28 175	157
		Total	7 346 719	3 992 595	3 275 659	50 051	x	4 877	1 804	20 894	839

https://www.ine.pt/xportal/xmain?xpid=INE&xpgid=ine_indicadores&contecto=pi&indOcorrCod=0007244&selTab=tab0

TRANSPORTATION BY TECNHOLOGY

- Diesel
- Gasoline
- biodiesel
- bioethanol
- GPL
- Natural gas



Monofuel

Bi-fuel (2 main tanks, e.g. LPG & gasoline)

Dual-fuel (main fuel tank & small tank start fuel)

Flex-fuel (1 main tank, both fuel mixed)

TRANSPORTATION BY EMISSION STANDARD

- Pre-Euro < 1992
- Euro I
- Euro II
- Euro III
- Euro IV
- Euro V
- Euro VI > 2014

Less sulfur (**in the fuel** 500 ppm to 5ppm)

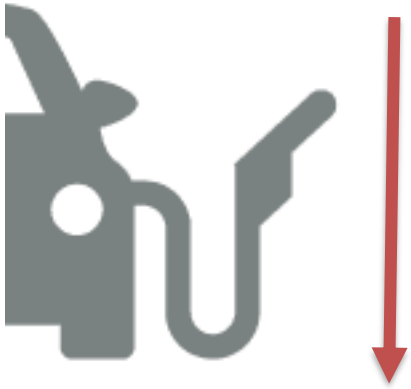
Less NOx (**in tailpipe** 0.5 g/km to 0.08 g/km)

Less PM (**in tailpipe** 0.18 g/km to 0.05 g/km)

https://dieselnet.com/standards/

TRANSPORTATION BY EMISSION STANDARD

The first **carbon dioxide emission targets** for new passenger cars were set in 1998/99 through **voluntary agreements** between the European Commission and the automotive industry represented by three manufacturer associations: ACEA (European Automobile Manufacturers Association), JAMA (Japanese Automobile Manufacturers Association) and KAMA (Korean Automobile Manufacturers Association).

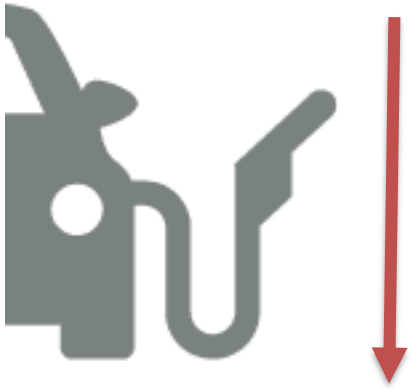


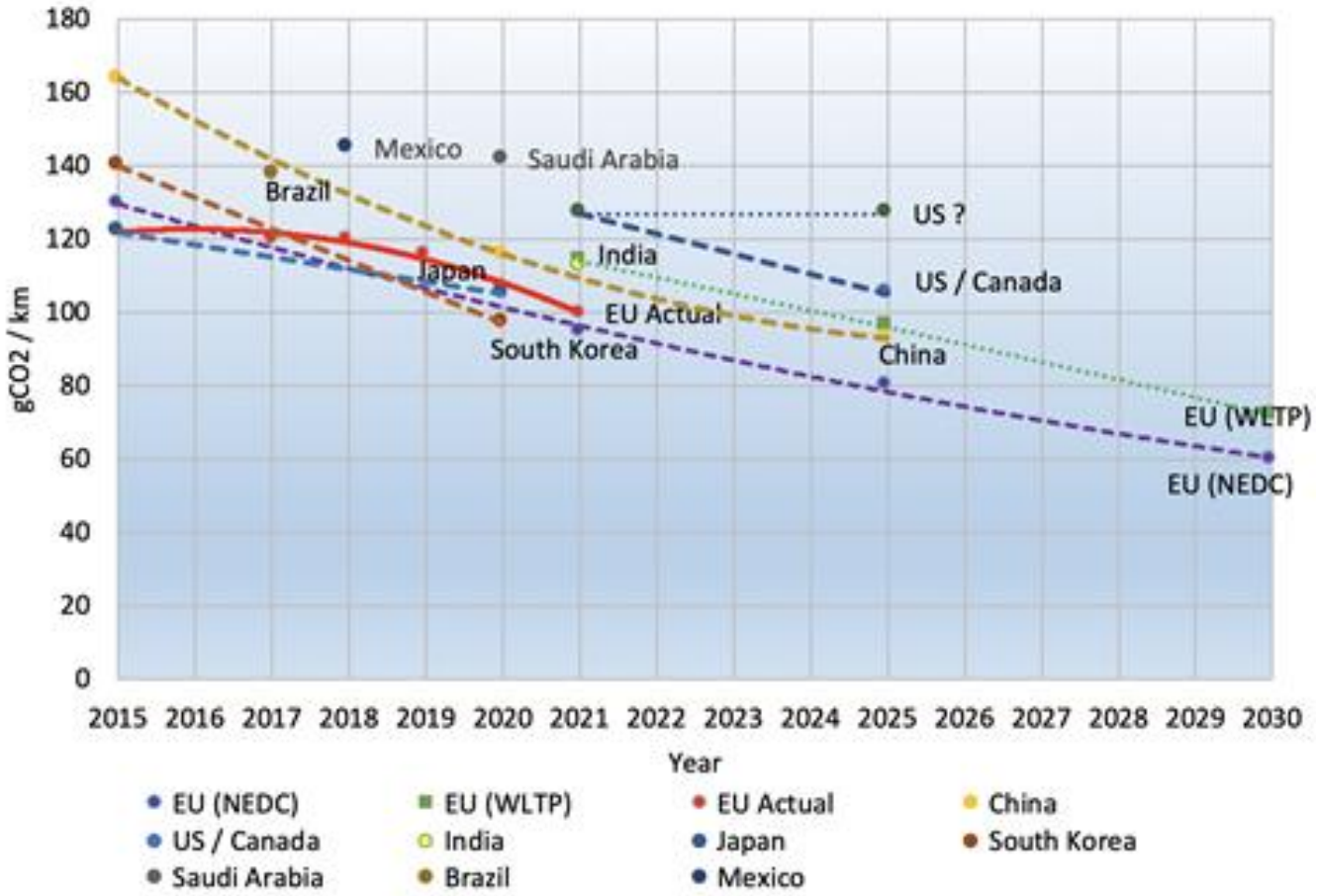
https://dieselnet.com/standards/

acea

> At the end of the day, motor vehicle manufacturers are fully committed to bringing CO2 emissions down to zero, supporting Europe's target of reaching climate neutrality by 2050.
>
> Share now

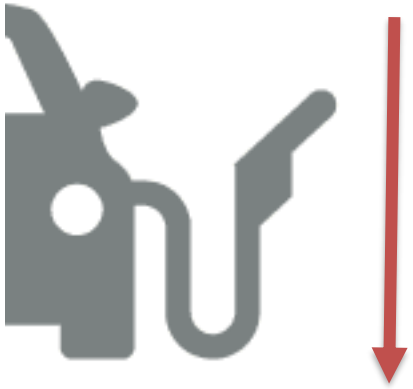
TRANSPORTATION BY EMISSION STANDARD





https://dieselnet.com/stan

TRANSPORTATION BY EMISSION STANDARD



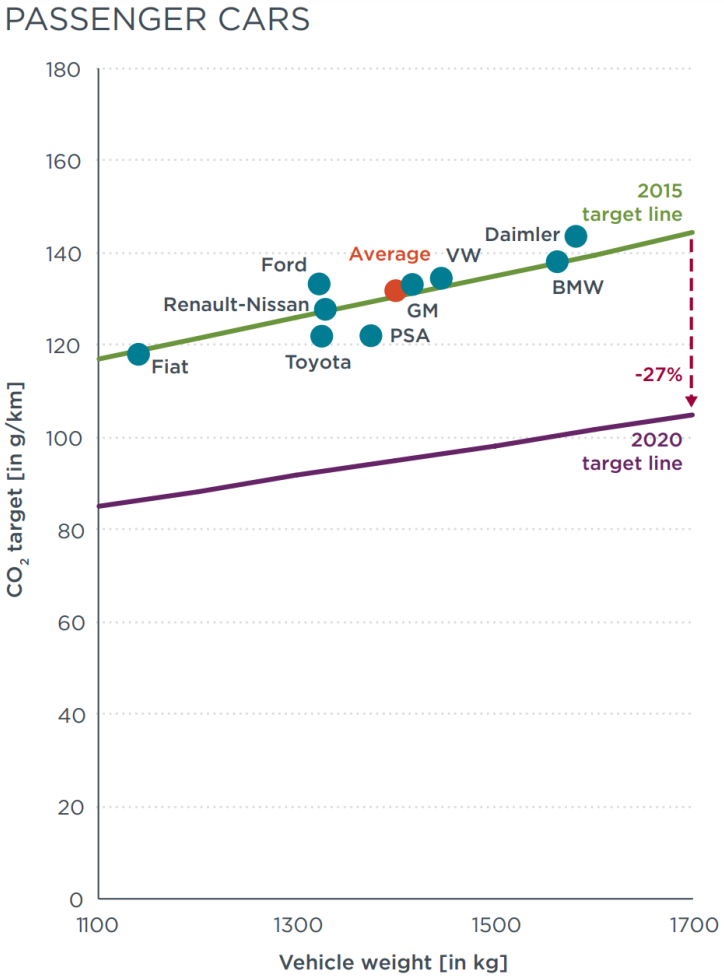


Figure 2. 2012 performance of key EU passenger car manufacturers, including 2015 and 2020 (effectively 2021) target lines. *Data source: EEA.*

TRANSPORTATION BY EMISSION STANDARD

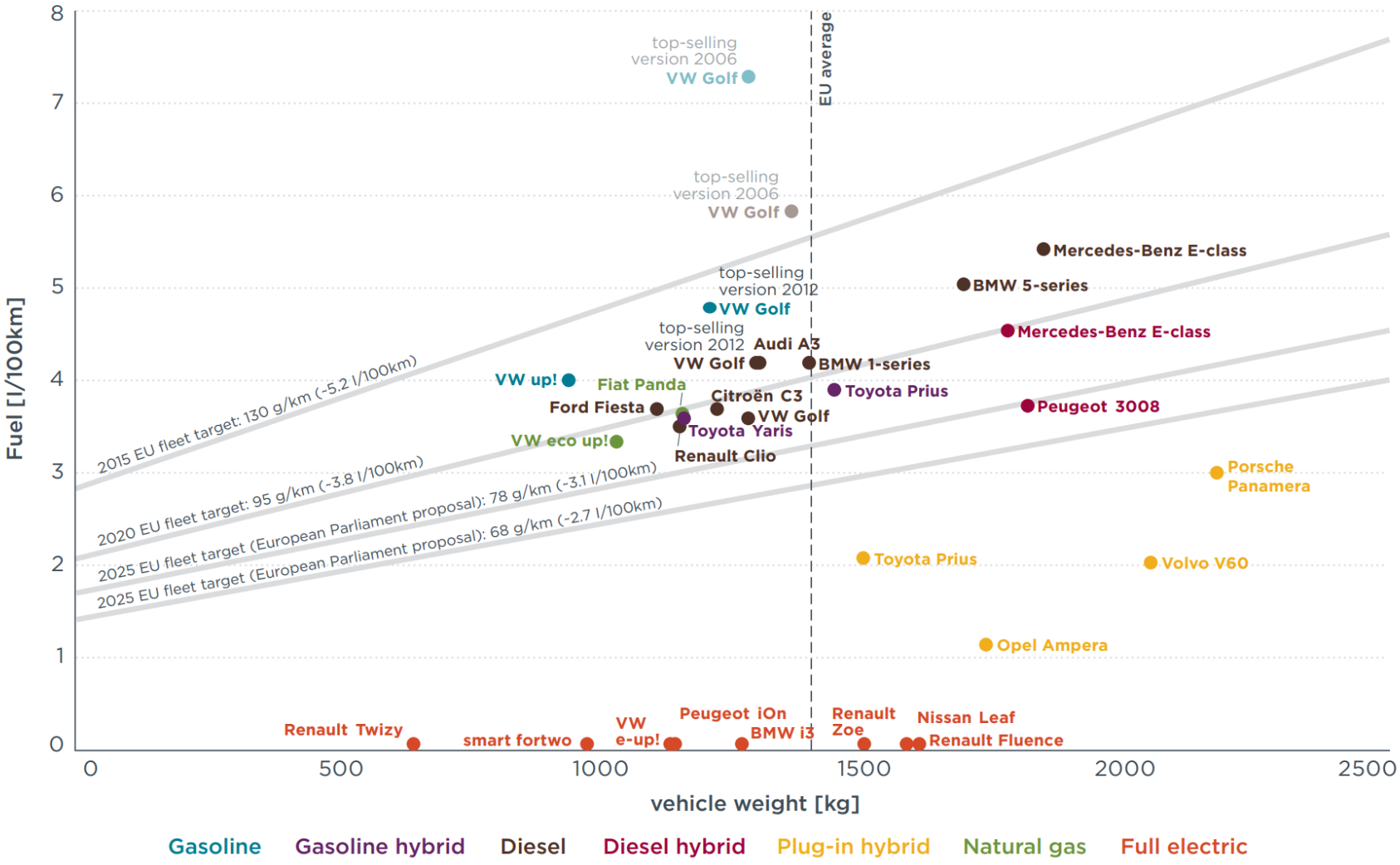


Figure 6. CO_2 emissions of selected commercially available passenger car models in the EU in 2013.

https://theicct.org/sites/default/files/publications/ICCTupdate_EU-95gram_jan2014.pdf

Energy units - equivalencies

Nm → Applied force to object in each dislocation

MJ → Usually related with heat

kWh → Usually related with electricity

kcal → Energy need to increase 1 kg of water by 1°C at a pressure of 1 atmosphere

Energy units - equivalencies

MJ → Usually related with heat

1 kWh → kJh/s *3600s/h = 3.6 MJ

1 Nm → 1 J

1 kcal → 4.184 kJ

Energy units - equivalencies

toe - ton oil equivalent

the amount of energy released by burning one tonne of crude oil

1 toe = 11.63 megawatt hours

1 toe = 41.87 gigajoules

1 toe = 39,683,205.411 BTU

1 toe = 7.11, 7.33, or 7.4 barrel of oil equivalent (boe)

1 tonne petroleum equivalent (**TPE**), as used in renewable energy = 45.217 GJ (gigajoules).

Energy units - equivalencies

toe - ton oil equivalent

the amount of energy released by burning one tonne of crude oil

1 000 000 goe = 41 870 000 kJ
1 gep = 0.04187 MJ

Fuel specifications

Fuel	Density	RON / CN	LHV	Elemental composition of Carbon	CO_2 emission factor (Fuel combustion Note)	
	kg/m³	---	MJ/kg	%m	g/MJ	kg/kg
Gasoline 2016 (E0)	743	95	43.2	86.4	73.4	3.17
Gasoline 2016 (E5)	746	95	42.3	84.7	73.3	3.10
Gasoline E10	748	95	41.5	82.8	73.3	3.04
Gasoline High Octane. Case 1 (100 RON)	761	100	42.4	84.8	73.3	3.11
Gasoline High Octane. Case 2 (102 RON / E5eq)	759	102	42.4	84.8	73.3	3.11
Diesel (B0)	832	51	43.1	86.1	73.2	3.16
Pyrolysis-based Diesel	832	51	43.1	86.1	73.2	3.2
Diesel B7 market blend	836	53	42.7	85.4	73.4	3.13

JEC Well-To-Wheels report v5

Fuel specifications

Fuel	Density	RON / CN	LHV	Elemental composition of Carbon	CO_2 emission factor (Fuel combustion Note)	
	kg/m^3	---	MJ/kg	%m	g/MJ	kg/kg
FAME	890	56	37.2	77.3	76.2	2.83
ED95	820	n. a.	25.4	49.4	71.3	1.81
FT Diesel	780	70	44.0	85.0	70.8	3.12
HVO	780	70	44.0	85.0	70.8	3.12
OME	1067	84	19.2	43.5	83.3	1.60

Note) CO_2 emission factor refers to the emissions released during the total combustion (full oxidation) of the carbon contained in the fuel molecules (expressed per MJ (or kg) of a certain fuel burnt). Therefore, the factor is not linked to the production process but to the chemical composition, carbon content, of the fuel itself.

Estimation of CO_2 emissions from fuel combustion for a given fuel can be summarised as follows:

CO_2 emissions from fuel combustion = Fuel consumption * CO_2 Emission factor.

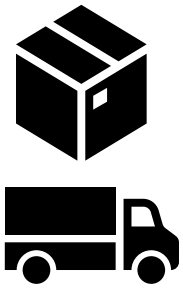
In the case of fuels from biogenic origin (biofuels), the emissions during combustion can be offset (net zero) as the carbon released during combustion is equal to the carbon captured by the plant/tree during its growing process). See Figure 8.

JEC Well-To-Wheels report v5

Energy units - equivalencies

MJ/pkm → Chemical energy consumed per passenger per each km travelled

kWh/pkm → Electrical energy consumed per passenger per each km travelled



MJ/tkm → Chemical energy consumed per tonne per each km travelled

kWh/tkm → Electrical energy consumed per tonne per each km travelled

Energy classification by stage

Primary energy – embodied in natural resources (e.g. crude oil hydrocarbon or natural gas hydrocarbon)

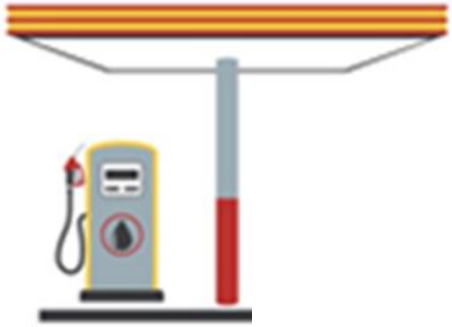
Secondary energy – changes primary energy in other energy form (e.g. outputs from oil refineries or power plants or biorefinery)

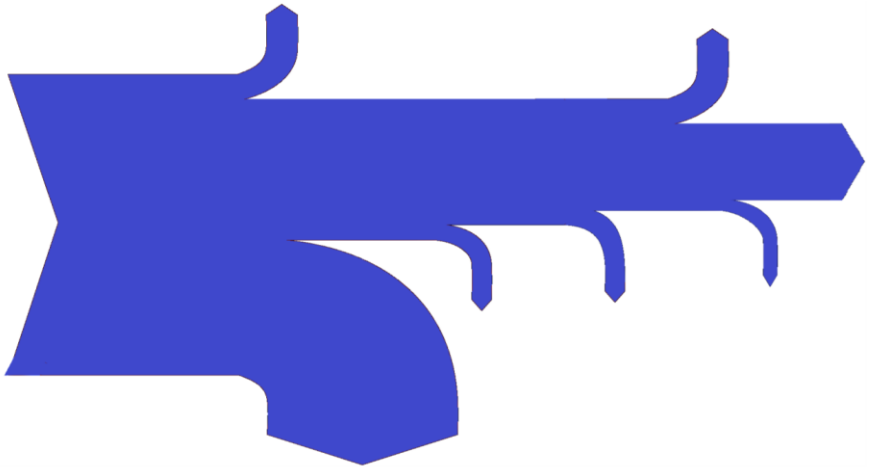
Final energy – sold and purchased by consumers (electricity, food, gasoline)

Useful energy – fraction of final energy that produces useful work for a specific task

Energy flows – Sankey diagram

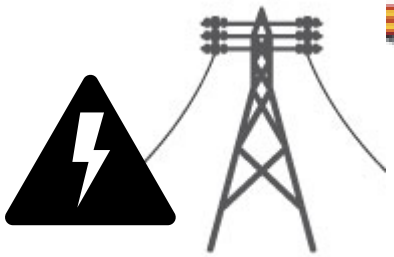
Primary Energy → **Secondary Energy** → **Final Energy** → **Useful Energy**

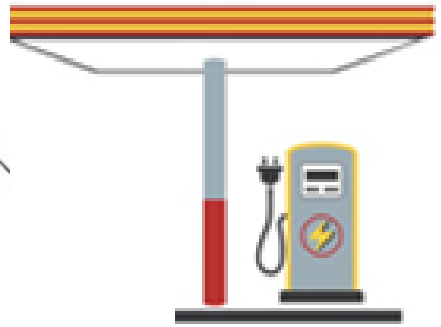


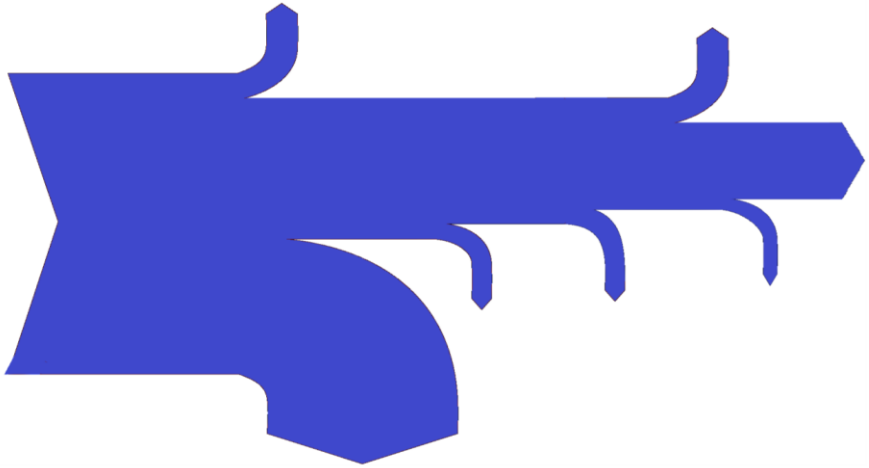


Energy flows – Sankey diagram

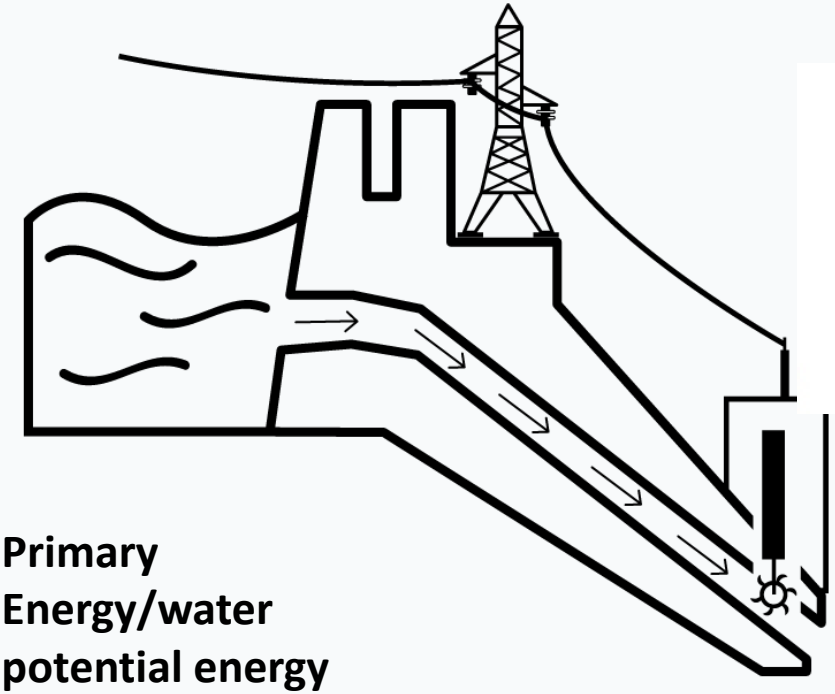
Primary Energy → **Secondary Energy** → **Final Energy** → **Useful Energy**







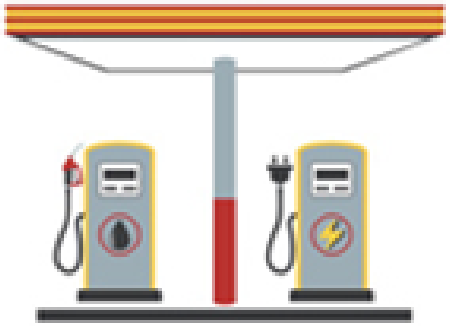
Energy flows

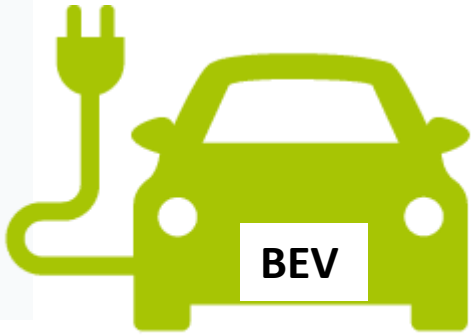


Primary Energy/water potential energy

Secondary Energy/High voltage electricity

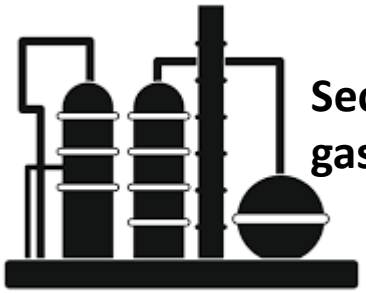
Final Energy/ Low voltage electricity





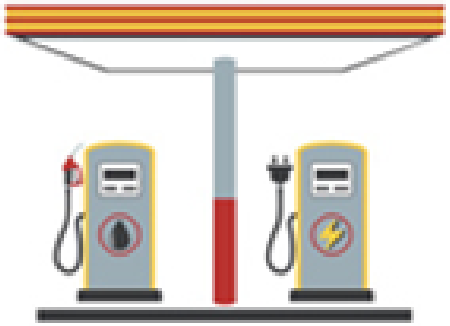
Useful Energy/kinetic Energy+losses

Energy flows

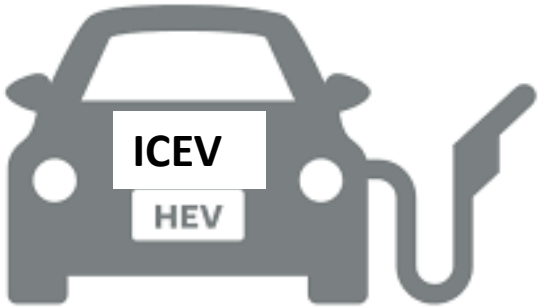


Secondary Energy/Diesel or gasoline or GPL

Final Energy



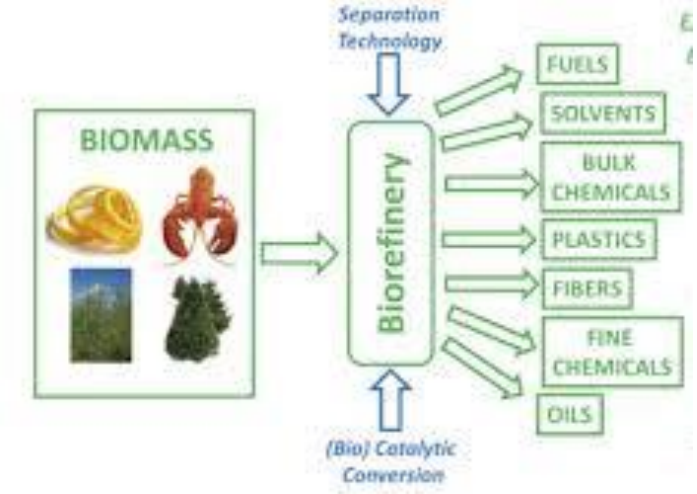
Primary Energy/ crude oil chemical energy



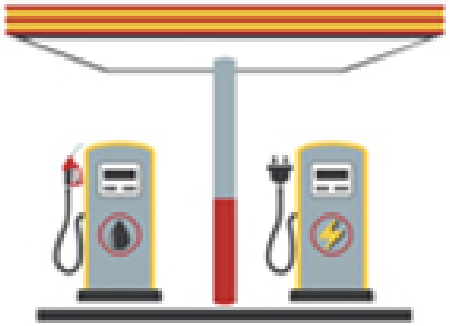
Useful Energy/kinetic Energy + losses

Energy flows

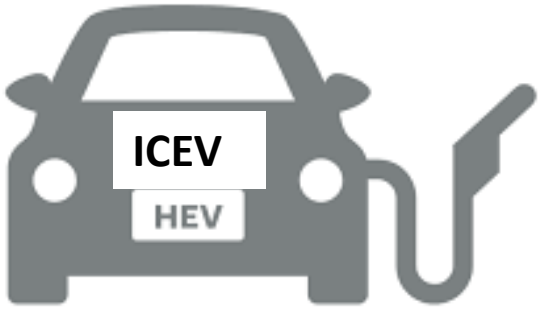
Secondary Energy/biodiesel or ethanol or hydrogen



Final Energy

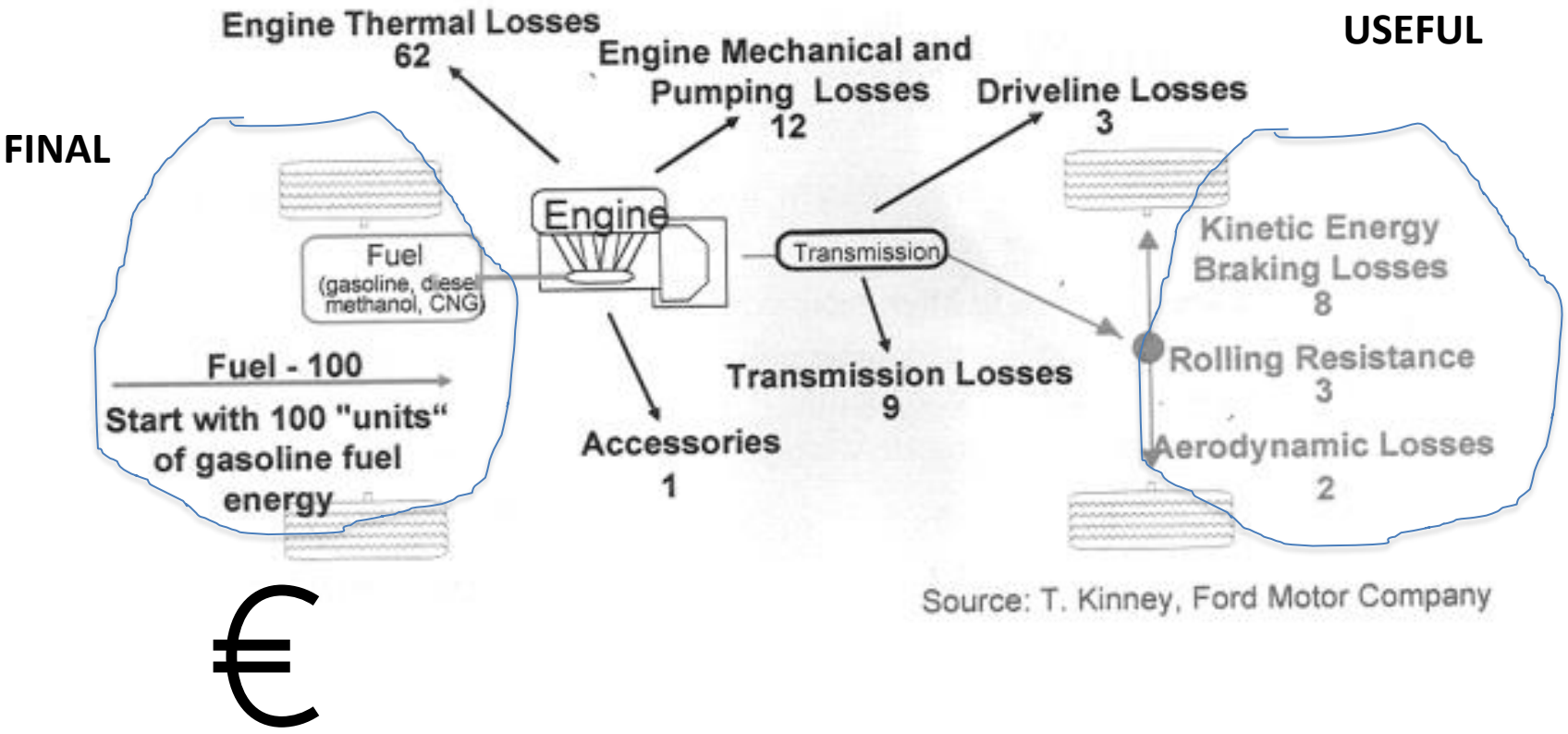


Primary Energy/ biomass chemical energy

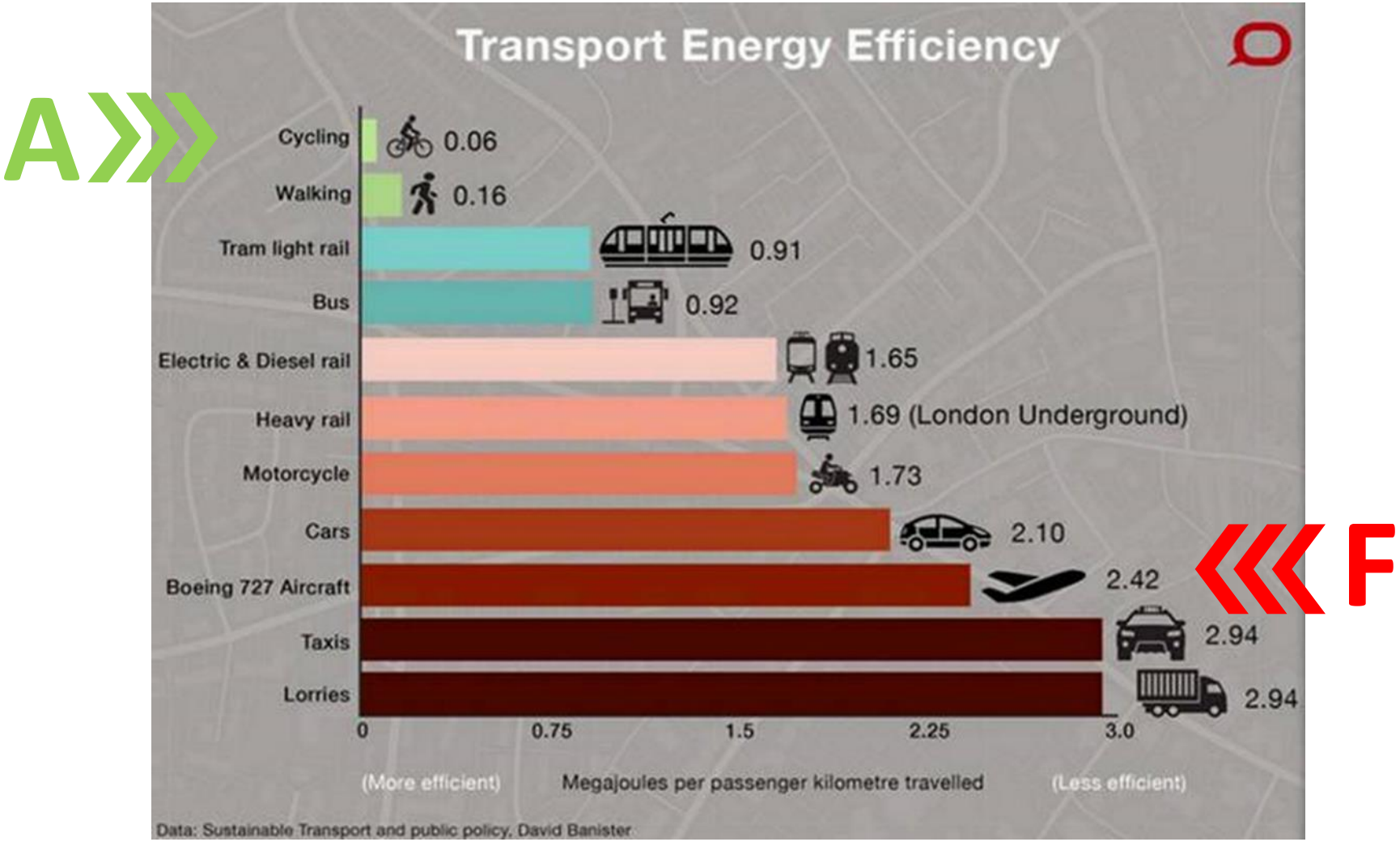


Useful Energy/kinetic Energy + losses

Energy flows – Sankey diagram

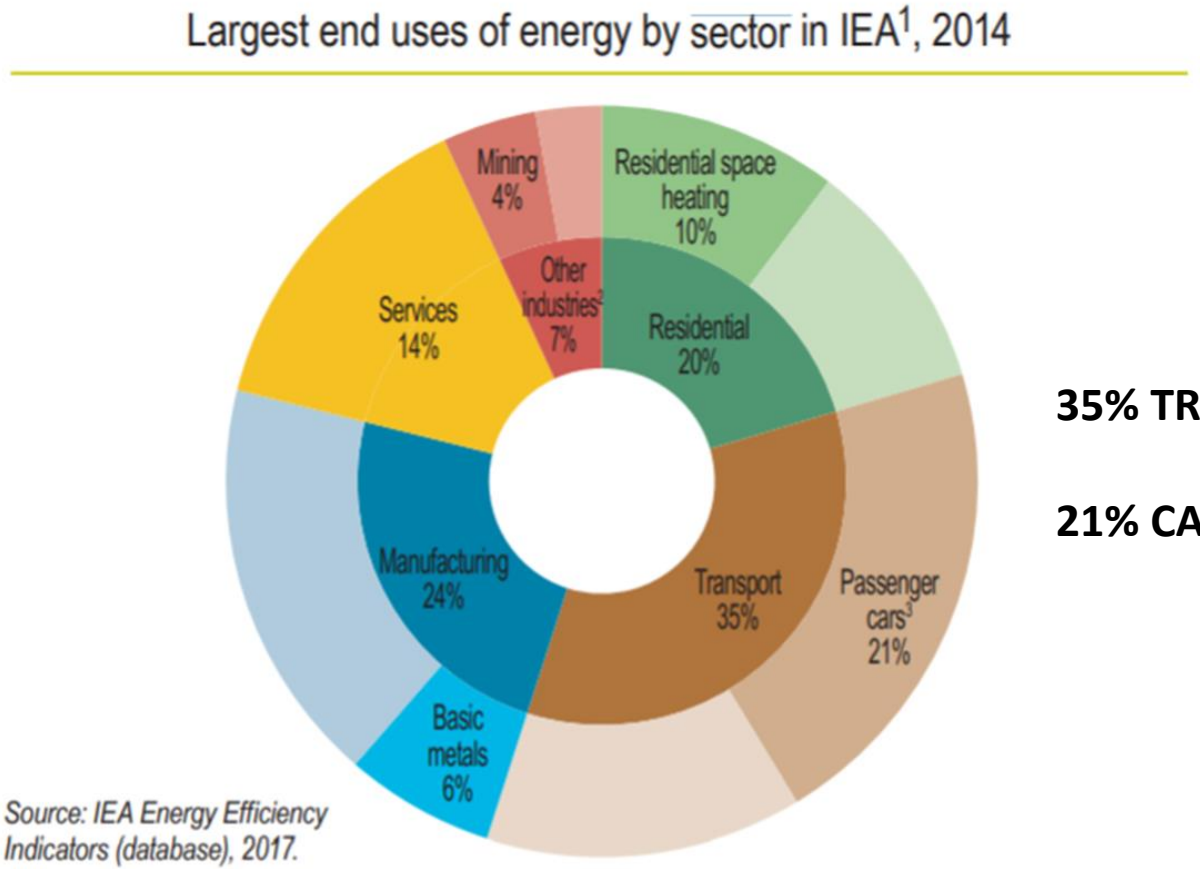


Energy efficiency (final to useful)



Energy flows – Transport system

Demand for Final Energy

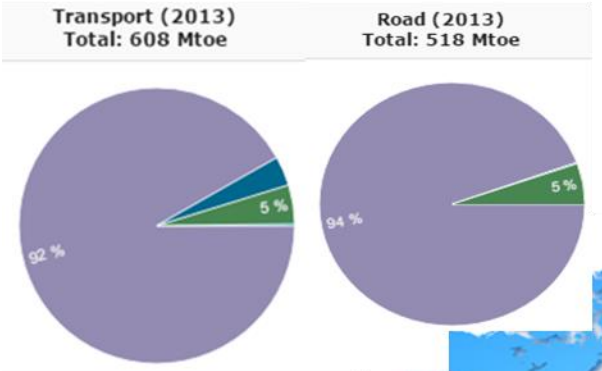


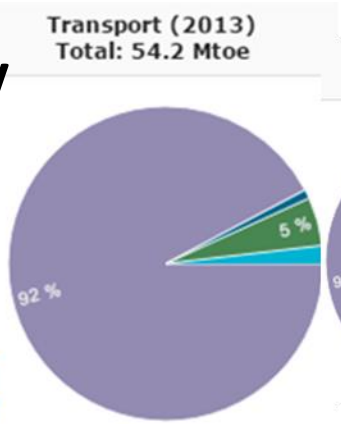
35% TRANSPORT

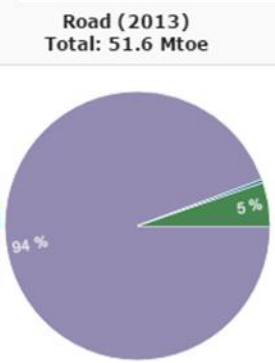
21% CARS

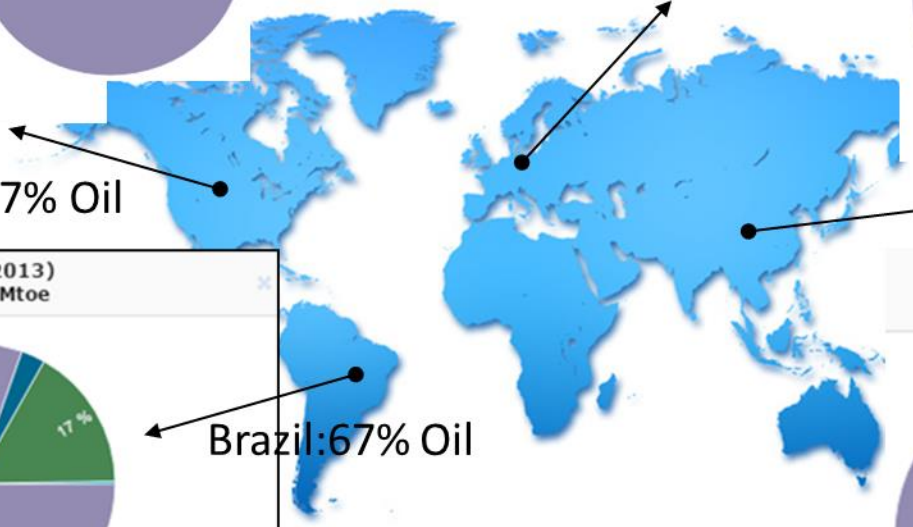
Energy flows – Transport system

Demand for Final Energy







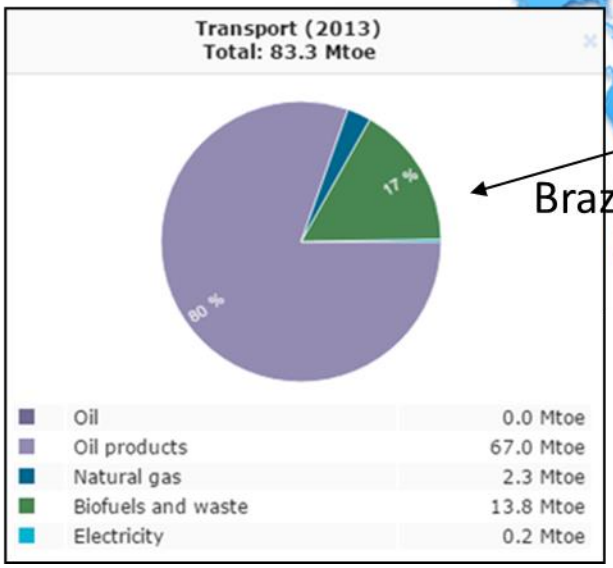


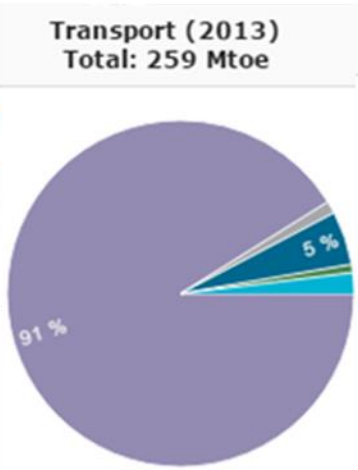
Germany: 53% Oil

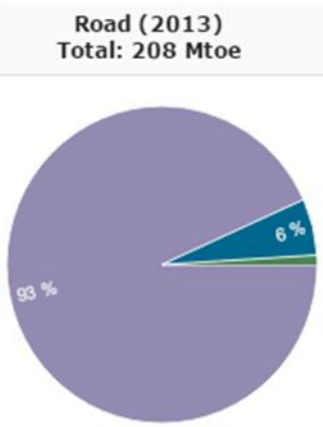
US:77% Oil

RPC:53% Oil

Brazil:67% Oil







Source: IEA 2015

Energy efficiency

Weiss, M., Cloos, K.C. & Helmers, E. Energy efficiency trade-offs in small to large electric vehicles. Environ Sci Eur 32, 46 (2020). https://doi.org/10.1186/s12302-020-00307-8

E-BIKE

Electric energy **0.17** and **2.25 kWh/100 km**

0.08 (MJ/PKM)

Biological energy

0.03 (MJ/PKM)

Conventional BIKE

Biological energy

0.06 (MJ/PKM)

Kinetic energy

Energy flows – burning fuel

164 Wh/km ?

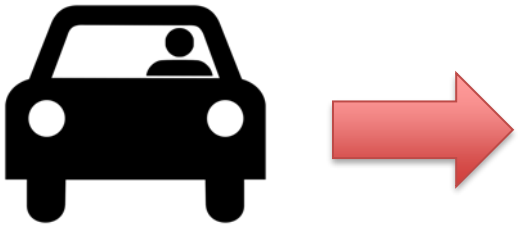
0.164 kWh/km*3.6MJ/kWh/(32.7 MJ/L)* (100km) = 1.8 L/100 km

164 Wh/km = **0.59 MJ/pkm** → 1.8 Lgasoline equivalent/100 km

Energy flows – burning fuel

5 Liters/100 km ?

5 Liters/100 km = 5L * 32.7 MJ/L * 1/(100km) = 1.635 MJ/km



1.64 MJ/pkm

Energy efficiency

210,4 kWh/100 km

61 kWh/100km

MJ/pkm???

Energy efficiency

https://www.carris.pt/media/cmgbpthv/relatorio-sustentabilidade-2012.pdf

24,68 gep/PK fuel (diesel &natural gas) = 24.68 * 0.04781 = **1.2 MJ/pkm**

28,44 gep/PK electric (tram&bus) = 1.38 MJ/pkm

2011

SUSTAINABILITY REPORTING

Energy efficiency

Emissões de CO_2 por Ck	Unidade	2010	2011
Tracção Eléctrica/Ck	gCO2e/Ck	4.262,22	3.607,71
Tracção Diesel/Ck	gCO2e/Ck	4.257,02	4.441,37
Tracção Total/Ck	**gCO2e/Ck**	**4.261,20**	**3.759,03**

Emissões de CO_2 por Pk	Unidade	2010	2011
Tracção Eléctrica/Pk	gCO2e/Pk	71,20	24,20
Tracção Diesel/Pk	gCO2e/Pk	11,46	101,87
Tracção Total/Pk	**gCO2e/Pk**	**35,20**	**28,93**

2011

Cálculos:

1 kWh ⇔ 0.00036059 Ton CO2 (fonte: www.edp.pt)

1 GJ Gasóleo = 0,0741 Ton CO2

1 GJ Gasolina = 0,0693 Ton CO2

MJ/pkm???

Energy efficiency

24.2 gCO2e*1kWh/360.59gCO2e = 0.067 kWh/PK

0.24 MJ/pkm

2011

Energy efficiency

https://ttsl.pt/empresa/documentos-oficiais/

0.024 L/pkm @ 2012 **(1.35 MJ/pkm)**

0.023 L/pkm @ 2013 **(1.3 MJ/pkm)**

2011

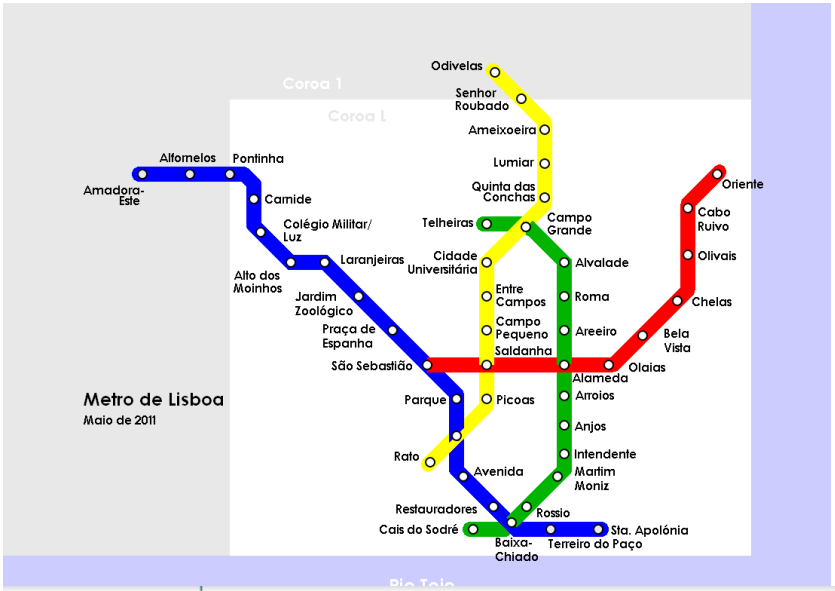
GRUPO TRANSTEJO

RELATÓRIO DE SUSTENTABILIDADE 2013

Anexo:
Tabela GRI "Global Reporting Initiative"

Energy efficiency

Indicadores de Consumo de Energia(10^3 kWh)	2009	2010	2011	Var. (2011/2010)
Tração/ lugar x km	0,011	0,013	0,016	18,9%
Tração/ Passageiro x km	0,063	0,065	0,061	-6,2%
Total / lugar x km	0,023	0,026	0,032	20,4%
Total/ Passageiro x km	0,128	0,129	0,123	-5,0%



Relatório de sustentabilidade 2011

kWh/pkm = **0.22 MJ/pkm**

2011

Transportes de Lisboa

Energy efficiency

DOI: 10.1260/0958-305X.21.6.577

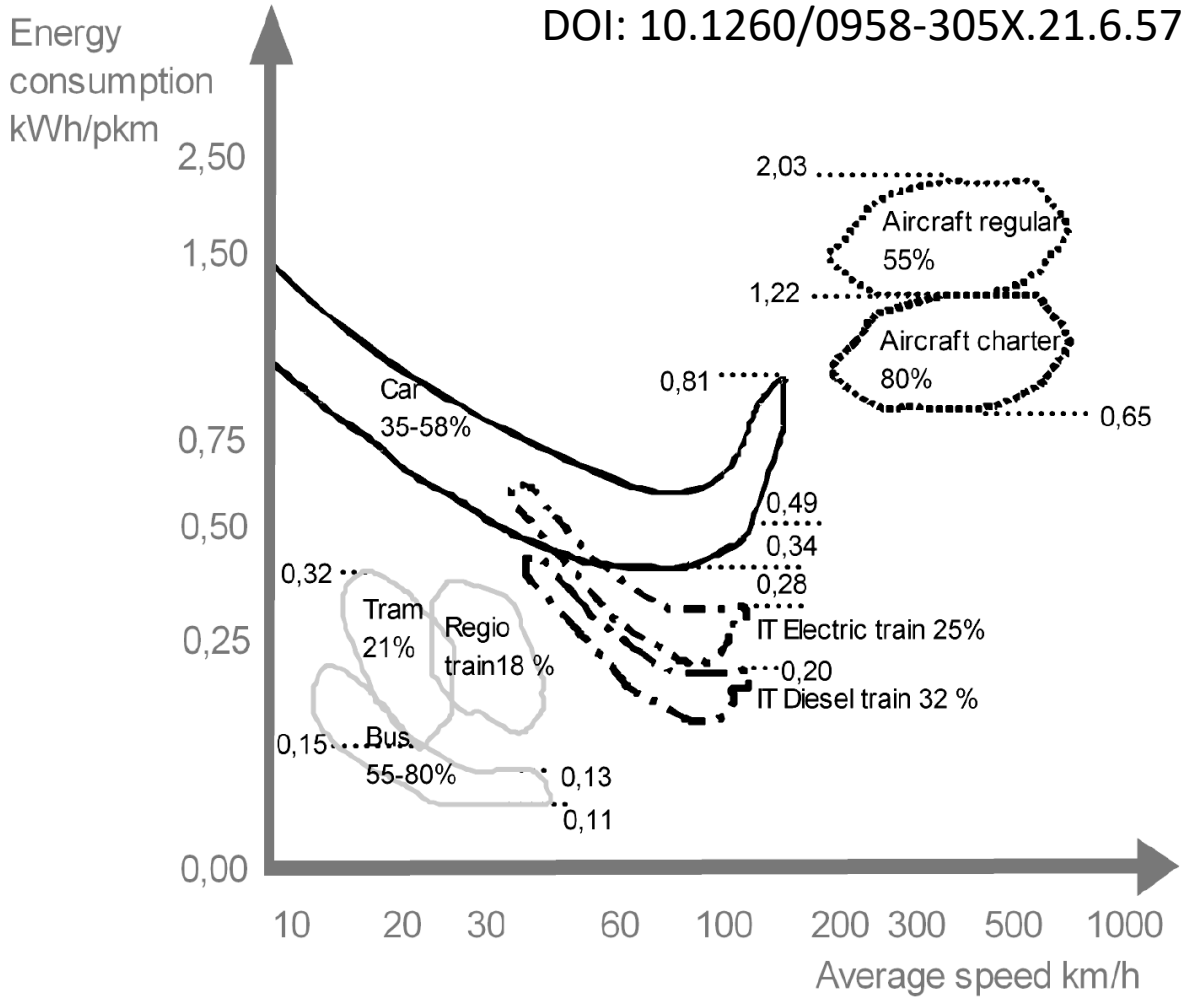


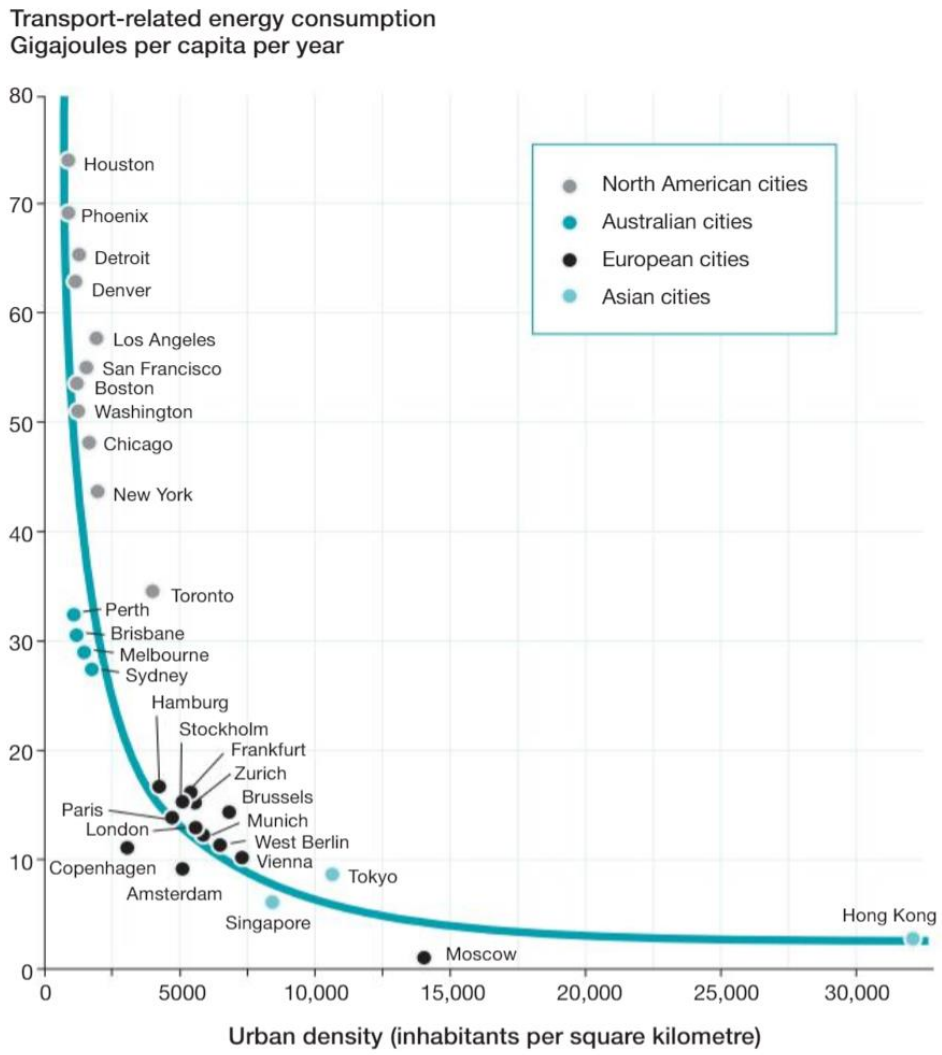
Figure 1. Energy consumption of passenger transport modes, average speed and occupation rate. Aircraft: scheduled airlines and charter; intercity train (IT): electric and diesel tractions; regional train (electric traction), tram, bus and car. Source: ITF (1990)

Statistics – energy consumption

Figure 5.3

Influences of urban densities on transport-related energy consumption, 32 cities (1989)

Source: Newman and Kenworthy, 1989; cited in Lefèvre, 2009.



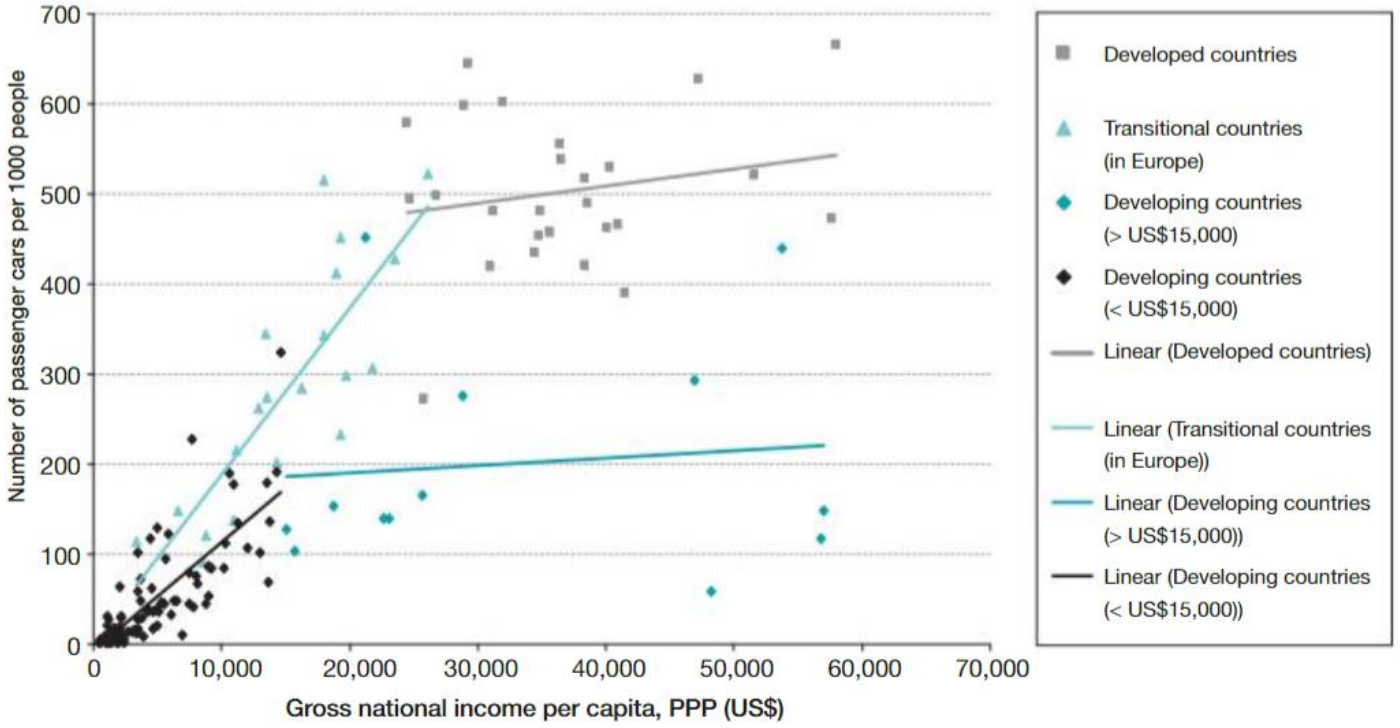
Statistics - Motorization index

Figure 8.1

Car ownership as a function of gross national income (2010)

Note: The figure includes data for 150 countries. Data are from the latest year available during the period 2005–2010, and refer to road motor vehicles, other than two-wheelers, intended for the carriage of passengers and designed to seat no more than nine people (including the driver). The gross national income per capita is based on PPP in 2010.

Source: Based on data from http://data.worldbank.org/indicator, last accessed 23 January 2013.



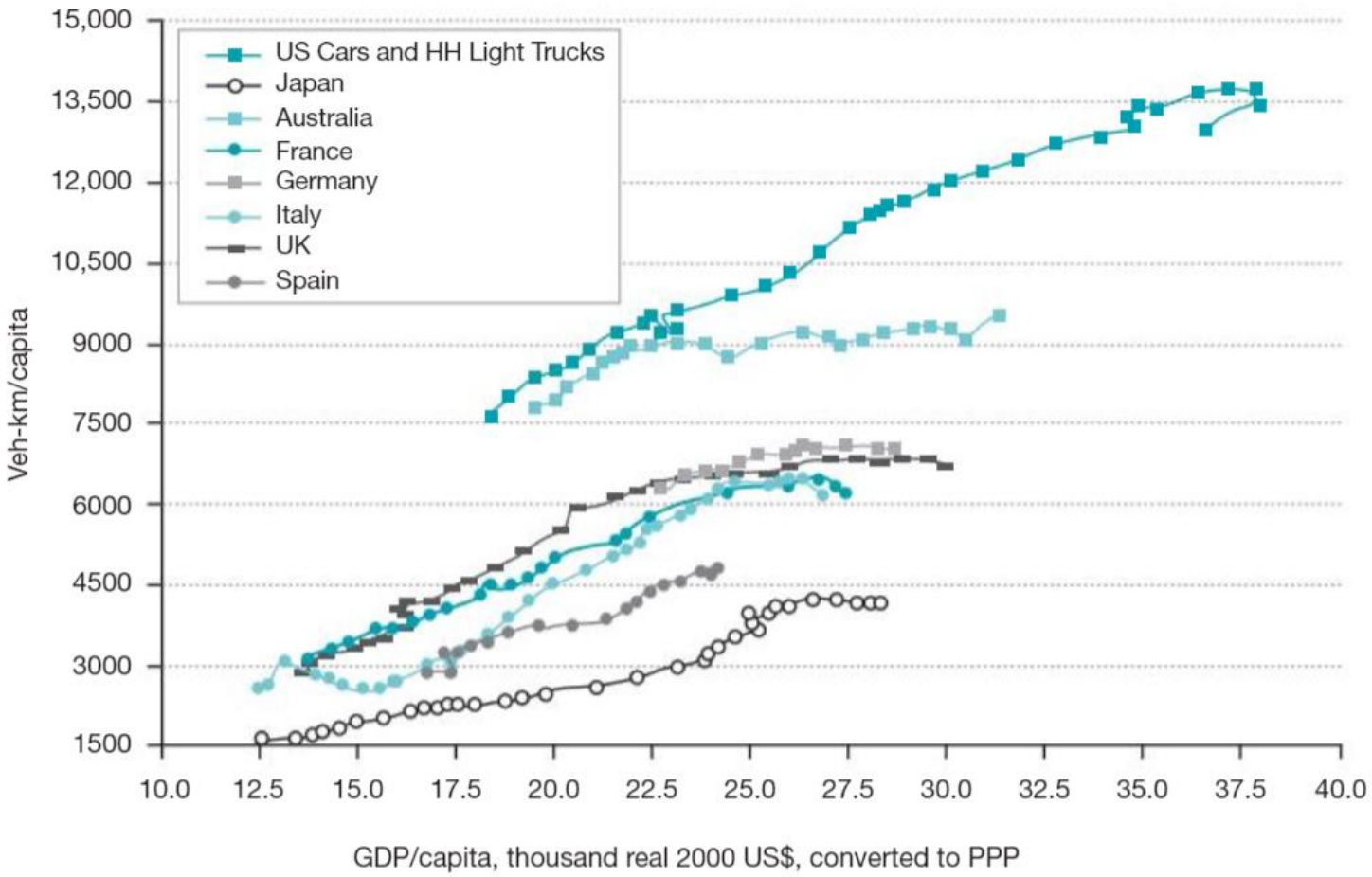
Statistics –Activity

Figure 2.12

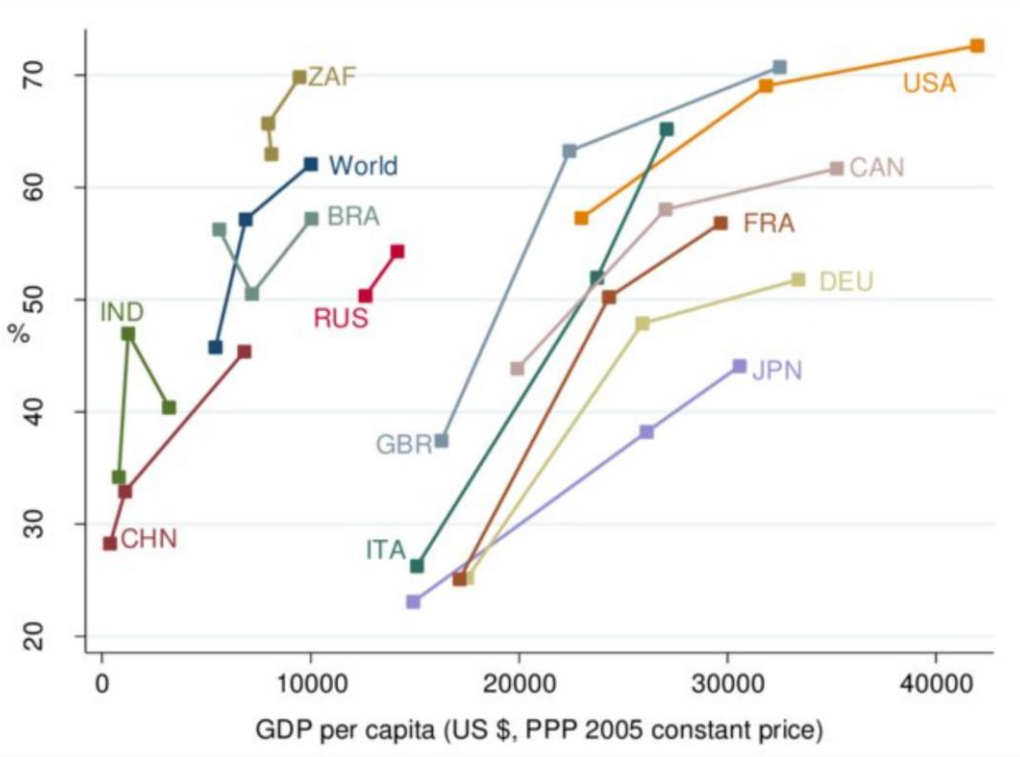
Vehicle kilometres travelled per capita for cars versus GDP per capita (1970–2008)

Notes: Data for some countries include SUVs and light trucks. PPP = purchasing power parity.

Sources: Millard-Ball and Schipper, 2011; Goodwin, 2012.



Statistics – Energy consumption



Figure

Caption

Figure 4 The proportion of road transport oil consumption in final oil consumption in

This figure was uploaded by Paul J. Burke

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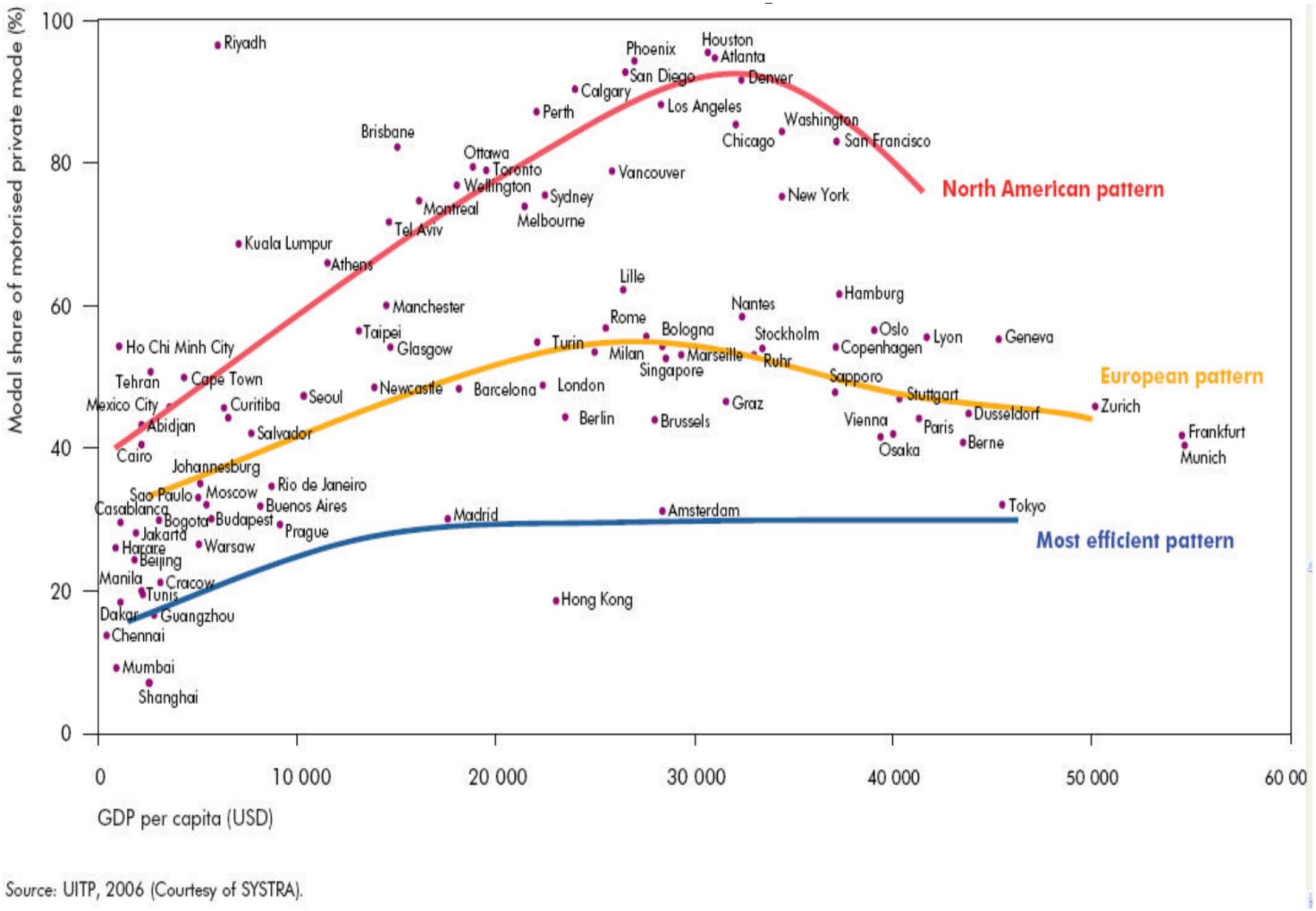
DOI: 10.1504/IJGEI.2015.070260

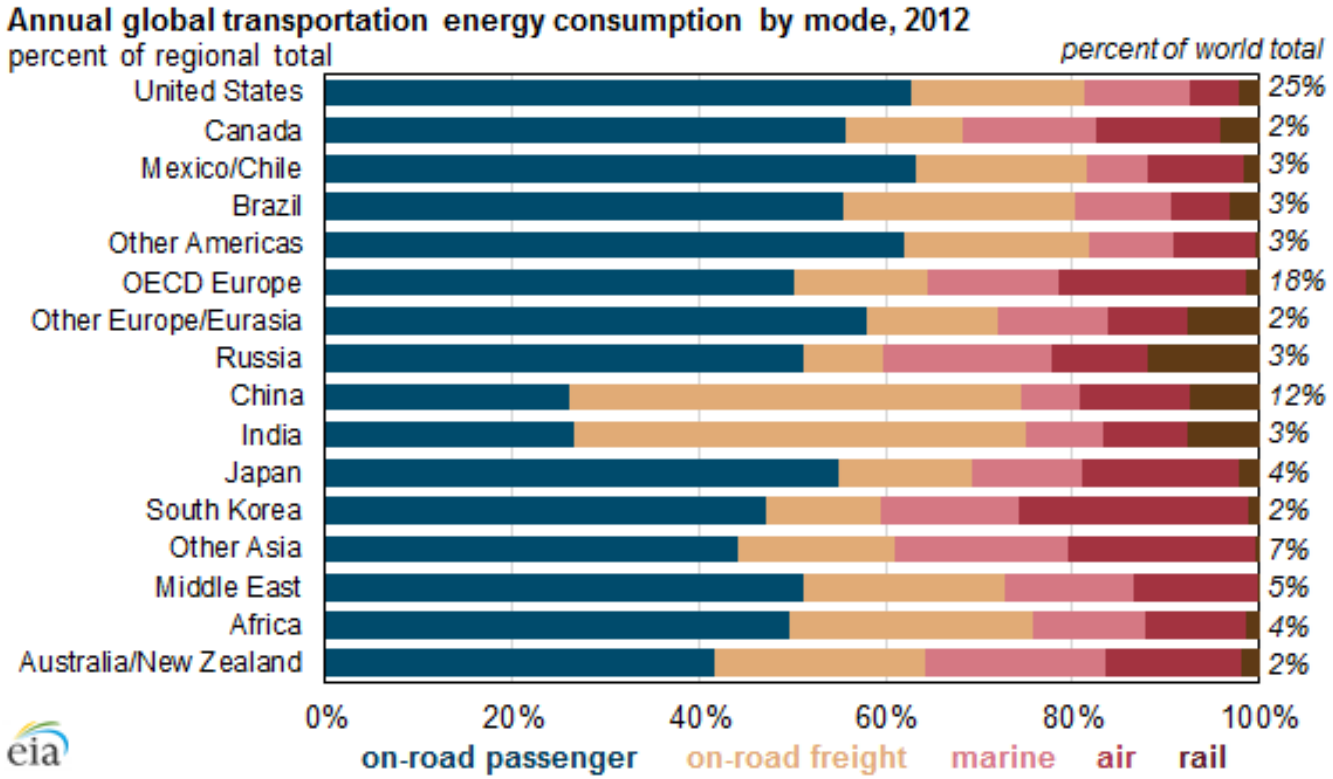
Statistics – Energy consumption



Source: UITP, 2006 (Courtesy of SYSTRA).

https://www.un.org/esa/dsd/susdevtopics/sdt_pdfs/meetings/ecm0609/Tom_Hamlin.pdf

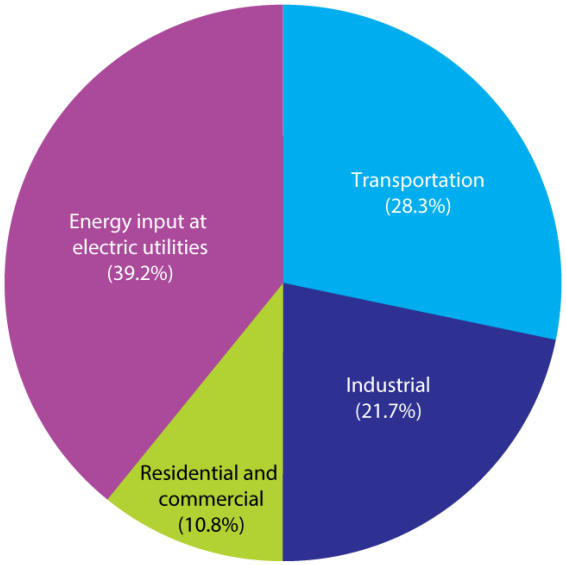
Statistics – Energy consumption



Source: EUROSTAT
http://ec.europa.eu/eurostat/statistics-explained/index.php/File:Energy_consumption_of_transport_by_mode_EU-28.jpg

Statistics – Energy consumption

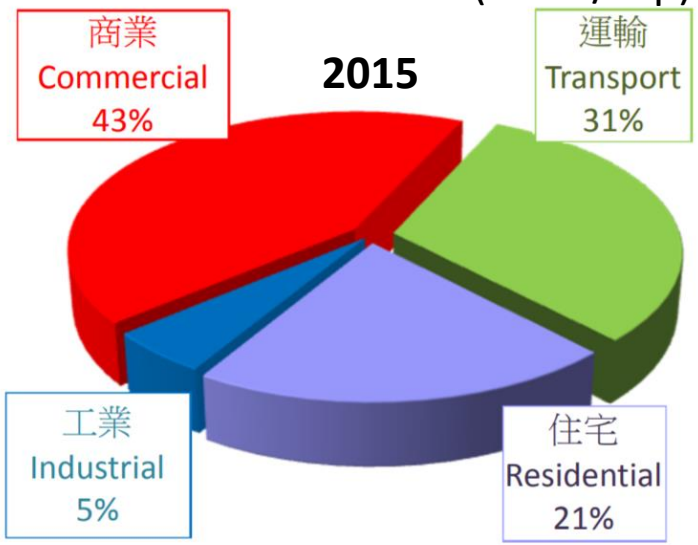
9053 Trillion BTU (282 GJ/cap)



US

821 Number cars / 1000 inhabitants

287 986 TJ (39 GJ/cap)



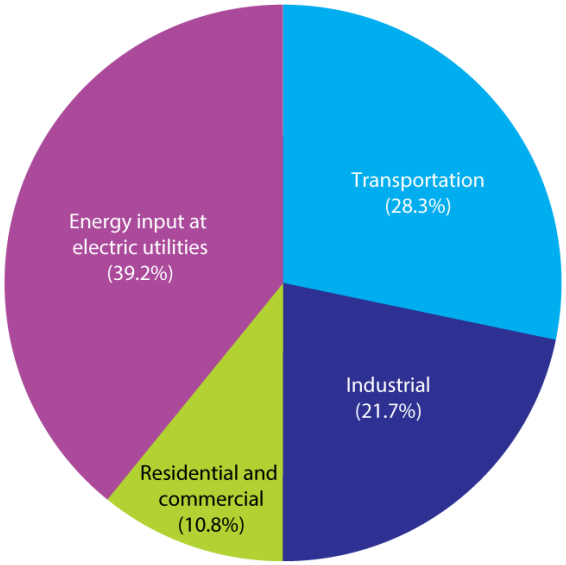
Hong-Kong

109 Number cars / 1000 inhabitants

https://www.emsd.gov.hk/filemanager/en/content_762/HKEEUD2017.pdf

Statistics – Energy consumption

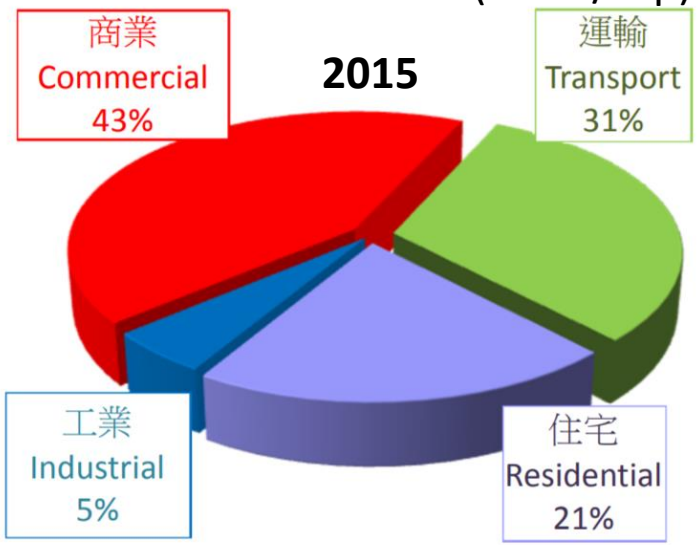
9053 Trillion BTU (282 GJ/cap)



US

0.2 $\frac{\text{Number bus}}{\text{1000 inhabitants}}$

287 986 TJ (39 GJ/cap)



Hong-Kong

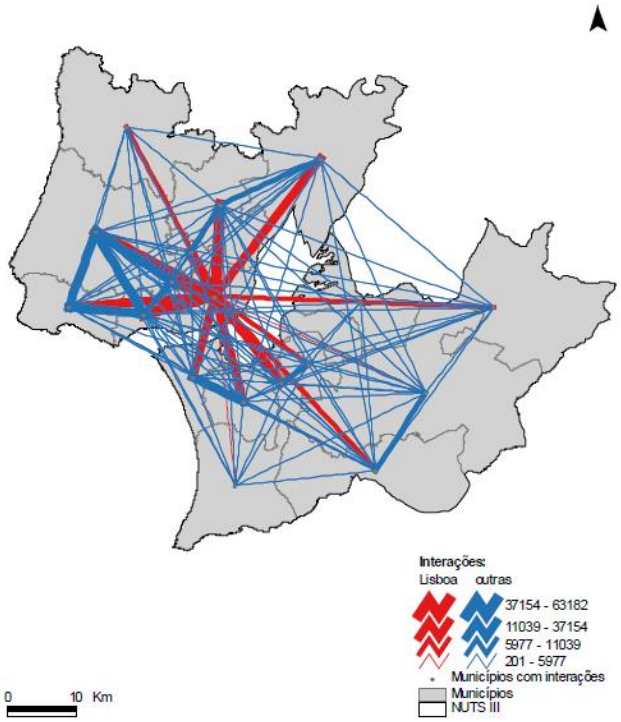
0.8 $\frac{\text{Number bus}}{\text{1000 inhabitants}}$

https://www.emsd.gov.hk/filemanager/en/content_762/HKEEUD2017.pdf

Energy consumption

$$\sum_i (pkm_i * MJ/pkm)$$

MOVIMENTOS PENDULARES (INTERAÇÕES REGIONAIS), 2011



Yearly updated…..

1.64 MJ/pkm

1.3 MJ/pkm

1.29 MJ/pkm

0.24 MJ/pkm

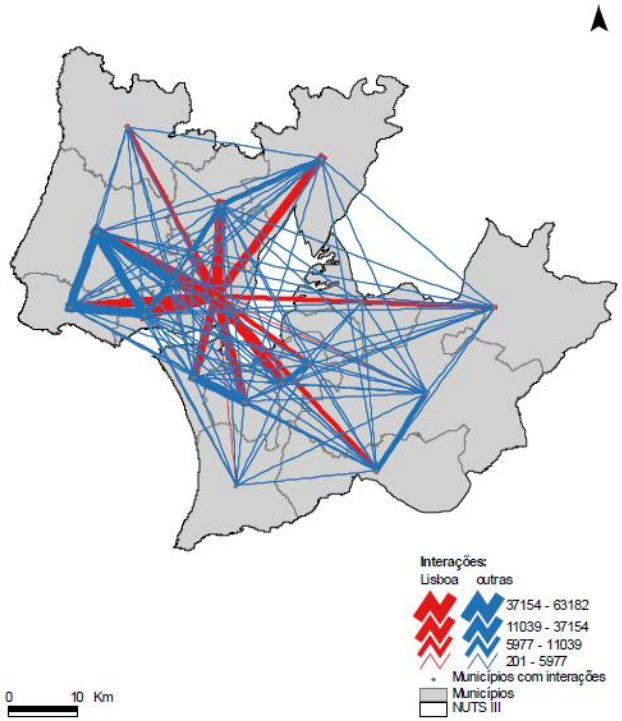
0.22 MJ/pkm

Energy consumption

$$\sum_i (pkm_i * MJ/pkm)$$

Yearly updated…..

MOVIMENTOS PENDULARES (INTERAÇÕES REGIONAIS), 2011



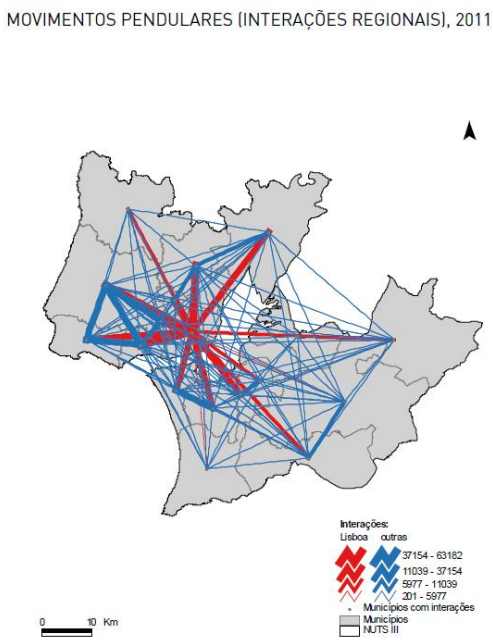
Estimative of gasoline and GPL sales within AML….

https://www.dgeg.gov.pt/pt/estatistica/energia/petroleo-e-derivados/vendas-anuais/

But Diesel is not separated by vehicle type…..

Energy consumption

$$\sum_i (pkm_i * MJ/pkm)$$



Energy consumption

Nº DESLOCAÇÕES ORIGEM-DESTINO

ORIGIN-DESTINATION MATRIX

INSTITUTO NACIONAL DE ESTATÍSTICA

CENSOS 2011

Censos 2011 | Info

Início :: Informação

› Alterar formato do quadro › Visualizar quadro

Quadro para download:

Microsoft Excel (versão 97 ou superior)

Local de residência ou destino (à data dos Censos 2001)	Movimentos pendulares (Interacções na unidade territorial - N.º) da população residente empregada ou estudante por Local de residência ou destino (à data dos Censos 2001) e Local de destino ou residência (à data dos Censos 2001); Decenal																		
	Período de referência dos dados																		
	2001																		
	Local de destino ou residência (à data dos Censos 2001)																		
	Portugal	Cascais	Lisboa	Loures	Mafra	Oeiras	Sintra	Vila Franca de Xira	Amadora	Odivelas	Alcochete	Almada	Barreiro	Moita	Montijo	Palmela	Seixal	Sesimbra	Setúbal
	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º
Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Continente	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cascais	0	0	27 983	1 260	350	13 717	12 280	507	2 251	678	0	1 142	210	0	0	0	521	0	257
Lisboa	0	27 983	0	56 197	4 341	48 340	71 981	22 537	51 033	40 058	1 151	31 696	12 507	7 943	2 910	3 133	26 263	3 354	5 929
Loures	0	1 260	56 197	0	2 199	3 089	4 938	8 900	3 365	6 013	0	1 473	389	216	225	227	743	0	336
Mafra	0	350	4 341	2 199	0	399	2 917	301	426	540	0	0	0	0	0	0	0	0	0
Oeiras	0	13 717	48 340	3 089	399	0	14 912	1 181	7 071	1 945	0	2 565	615	321	0	246	1 502	214	516
Sintra	0	12 280	71 981	4 938	2 917	14 912	0	1 522	16 842	3 843	0	2 189	365	249	206	276	905	0	639
Vila Franca de Xira	0	507	22 537	8 900	301	1 181	1 522	0	1 045	790	0	598	0	0	0	0	278	0	268
Amadora	0	2 251	51 033	3 365	426	7 071	16 842	1 045	0	3 102	0	1 690	366	0	0	0	731	0	378
Odivelas	0	678	40 058	6 013	540	1 945	3 843	790	3 102	0	0	696	0	0	0	0	255	0	0
Alcochete	0	0	1 151	0	0	0	0	0	0	0	0	0	0	205	2 387	306	0	0	0
Almada	0	1 142	31 696	1 473	0	2 565	2 189	598	1 690	696	0	0	1 188	828	438	1 027	16 107	1 150	2 298
Barreiro	0	210	12 507	389	0	615	365	0	366	0	0	1 188	0	6 895	547	2 421	1 813	568	1 894
Moita	0	0	7 943	216	0	321	249	0	0	0	205	828	6 895	0	1 221	2 513	992	231	1 700
Montijo	0	0	2 910	225	0	0	206	0	0	0	2 387	438	547	1 221	0	1 781	375	0	874
Palmela	0	0	3 133	227	0	246	276	0	0	0	306	1 027	2 421	2 513	1 781	0	1 676	623	9 788
Seixal	0	521	26 263	743	0	1 502	905	278	731	255	0	16 107	1 813	992	375	1 676	0	2 091	2 769
Sesimbra	0	0	3 354	0	0	214	0	0	0	0	0	1 150	568	231	0	623	2 091	0	1 425
Setúbal	0	257	5 929	336	0	516	639	268	378	0	0	2 298	1 894	1 700	874	9 788	2 769	1 425	0

Movimentos pendulares (Interacções na unidade territorial - N.º) da população residente empregada ou estudante por Local de residência ou destino (à data dos Censos 2001) e Local de destino ou residência (à data dos Censos 2001); Decenal - INE, Recenseamento da população e habitação - Censos 2001

Última atualização destes dados: 21 de maio de 2008

Energy consumption

INSTITUTO NACIONAL DE ESTATÍSTICA
STATISTICS PORTUGAL

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Início / Produtos / Base de Dados

Principais indicadores | Principais quadros | Base de dados | Microdados | Estatísticas territoriais | Pirâmides etárias

› Incluir/retirar indicadores › Alterar condições de seleção › Alterar formato do quadro › Visualizar quadro

Local de residência (à data dos Censos 2011)	Meio de transporte mais utilizado nos movimentos pendulares (N.º) por Local de residência (à data dos Censos 2011) e Principal meio de transporte; Decenal											
	Período de referência dos dados											
	2011											
	Principal meio de transporte											
	Total	A pé	Automovel ligeiro - como condutor	Automovel ligeiro - como passageiro	Autocarro	Transporte colectivo da empresa ou da escola	Metropolitano	Comboio	Motociclo	Bicicleta	Barco	Outro
	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º
Portugal	5 920 531	972 098	2 589 136	1 058 089	698 326	190 678	105 591	173 129	69 848	31 179	17 019	15 438
Continente	5 615 088	922 430	2 464 757	994 800	650 348	174 856	105 591	173 129	66 785	30 878	16 878	14 636
Grande Porto	736 344	117 922	314 092	131 693	102 160	12 494	34 757	11 749	7 361	2 389	52	1 675
Grande Lisboa	1 224 331	181 654	474 183	189 759	190 416	15 976	63 067	94 438	9 104	1 818	410	3 506

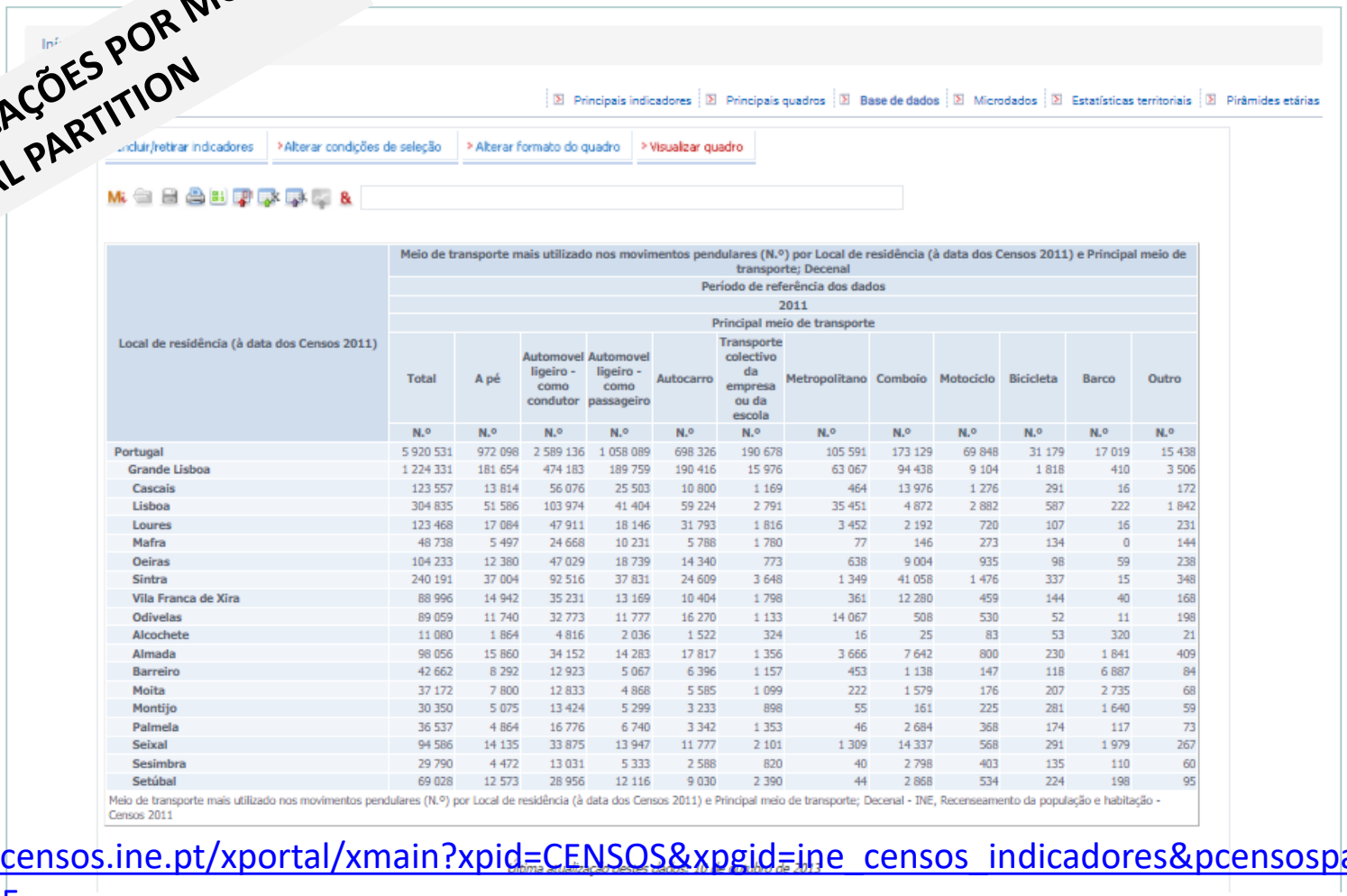
Meio de transporte mais utilizado nos movimentos pendulares (N.º) por Local de residência (à data dos Censos 2011) e Principal meio de transporte; Decenal - INE, Recenseamento da população e habitação - Censos 2011

Última atualização destes dados: 10 de outubro de 2013

https://censos.ine.pt/xportal/xmain?xpid=CENSOS&xpgid=ine_censos_indicadores&pcensospagenumber=15

Energy consumption

Nº DESLOCAÇÕES POR MODO ⇒ MODAL PARTITION



Principais indicadores | Principais quadros | Base de dados | Microdados | Estatísticas territoriais | Pirâmides etárias

Incluir/retirar indicadores | Alterar condições de seleção | Alterar formato do quadro | Visualizar quadro

Meio de transporte mais utilizado nos movimentos pendulares (N.º) por Local de residência (à data dos Censos 2011) e Principal meio de transporte; Decenal

Período de referência dos dados: 2011

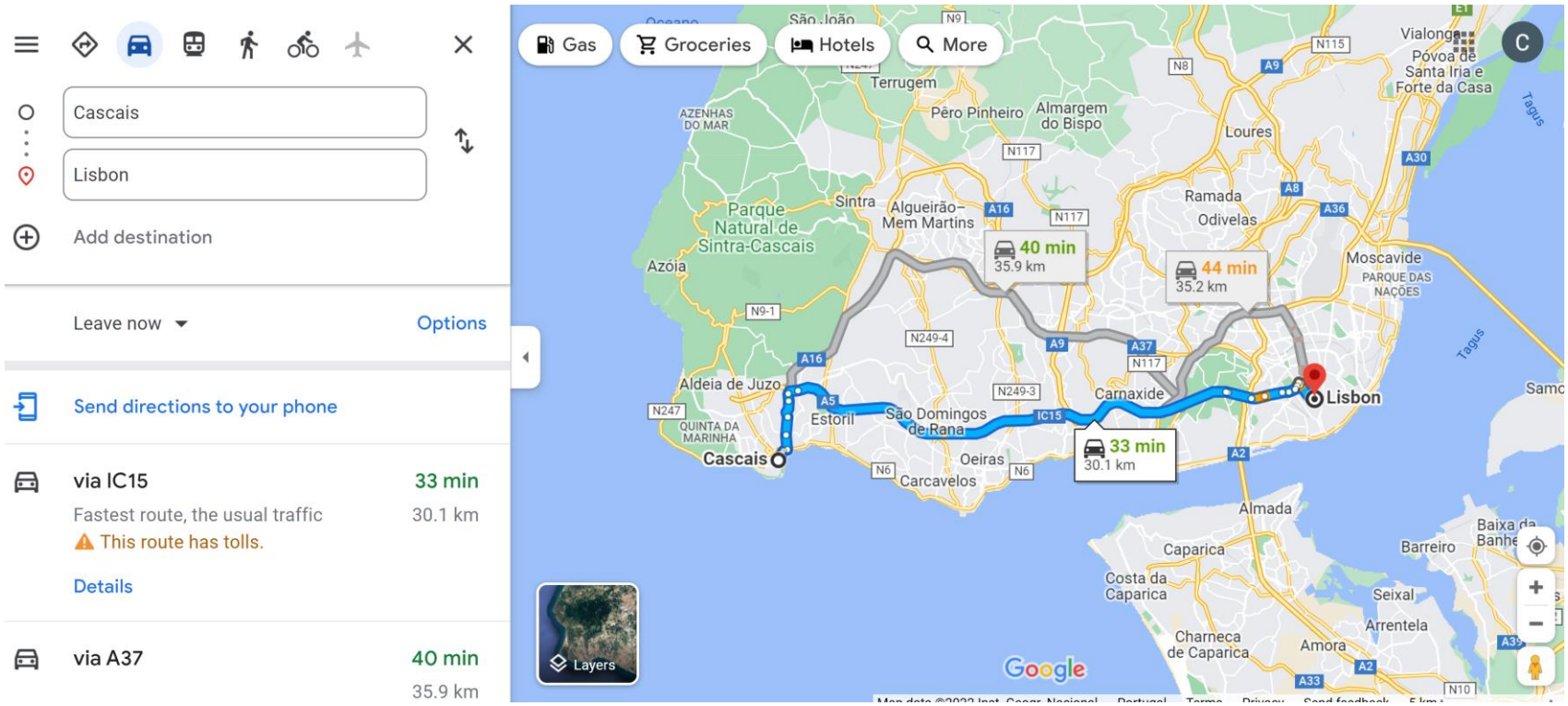
Local de residência (à data dos Censos 2011)	Principal meio de transporte											
	Total	A pé	Automovel ligeiro - como condutor	Automovel ligeiro - como passageiro	Autocarro	Transporte colectivo da empresa ou da escola	Metropolitano	Comboio	Motociclo	Bicicleta	Barco	Outro
	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º	N.º
Portugal	5 920 531	972 098	2 589 136	1 058 089	698 326	190 678	105 591	173 129	69 848	31 179	17 019	15 438
Grande Lisboa	1 224 331	181 654	474 183	189 759	190 416	15 976	63 067	94 438	9 104	1 818	410	3 506
Cascais	123 557	13 814	56 076	25 503	10 800	1 169	464	13 976	1 276	291	16	172
Lisboa	304 835	51 586	103 974	41 404	59 224	2 791	35 451	4 872	2 882	587	222	1 842
Loures	123 468	17 084	47 911	18 146	31 793	1 816	3 452	2 192	720	107	16	231
Mafra	48 738	5 497	24 668	10 231	5 788	1 780	77	146	273	134	0	144
Oeiras	104 233	12 380	47 029	18 739	14 340	773	638	9 004	935	98	59	238
Sintra	240 191	37 004	92 516	37 831	24 609	3 648	1 349	41 058	1 476	337	15	348
Vila Franca de Xira	88 996	14 942	35 231	13 169	10 404	1 798	361	12 280	459	144	40	168
Odivelas	89 059	11 740	32 773	11 777	16 270	1 133	14 067	508	530	52	11	198
Alcochete	11 080	1 864	4 816	2 036	1 522	324	16	25	83	53	320	21
Almada	98 056	15 860	34 152	14 283	17 817	1 356	3 666	7 642	800	230	1 841	409
Barreiro	42 662	8 292	12 923	5 067	6 396	1 157	453	1 138	147	118	6 887	84
Moita	37 172	7 800	12 833	4 868	5 585	1 099	222	1 579	176	207	2 735	68
Montijo	30 350	5 075	13 424	5 299	3 233	898	55	161	225	281	1 640	59
Palmela	36 537	4 864	16 776	6 740	3 342	1 353	46	2 684	368	174	117	73
Seixal	94 586	14 135	33 875	13 947	11 777	2 101	1 309	14 337	568	291	1 979	267
Sesimbra	29 790	4 472	13 031	5 333	2 588	820	40	2 798	403	135	110	60
Setúbal	69 028	12 573	28 956	12 116	9 030	2 390	44	2 868	534	224	198	95

Meio de transporte mais utilizado nos movimentos pendulares (N.º) por Local de residência (à data dos Censos 2011) e Principal meio de transporte; Decenal - INE, Recenseamento da população e habitação - Censos 2011

https://censos.ine.pt/xportal/xmain?xpid=CENSOS&xpgid=ine_censos_indicadores&pcensospagenumber=15

Energy consumption

GOOGLE MAPS DISTANCES



Energy consumption

km	Cascais	Lisboa	Loures	Mafra	Oeiras	Sintra	Vila Franca de Xira	Amadora	Odivelas	Alcochete	Almada	Barreiro	Moita	Montijo	Palmela	Seixal	Sesimbra	Setúbal
Cascais		30	41	36	18	17	69	29	34	73	40	63	62	65	65	50	62	76
Lisboa			18	43	20	30	40	12	13	37	12	45	38	33	46	23	39	50
Loures				26	30	34	33	15	12	37	25	52	38	33	52	37	67	54
Mafra					48	24	50	40	30	65	55	77	76	65	75	70	80	84
Oeiras						25	56	20	28	60	27	60	57	60	57	39	53	68
Sintra							58	24	28	60	39	68	60	55	70	47	62	73
Vila Franca de Xira								35	31	50	49	65	53	46	65	60	70	67
Amadora									9	40	18	50	42	36	50	29	44	55
Odivelas										36	21	48	42	31	51	31	46	53
Alcochete											55	32	20	9	30	40	50	38
Almada												33	33	45	37	17	35	42
Barreiro													10	26	27	20	32	40
Moita														12	13	22	32	26
Montijo															24	30	43	33
Palmela																28	35	10
Seixal																	26	33
Sesimbra																		45
Setúbal																		

erro	5%	%

Energy consumption

%	Local residência/ Modo	Automóvel	Autocarro	Metro	Comboio	Barco
	Cascais	0.645702	0.200722	0.061334	0.091844	0.000399
	Lisboa	0.755333	0.11082	0.004296	0.129403	0.000148
	Loures	0.586348	0.250123	0.142983	0.01965	0.000895
	Mafra	0.627167	0.319095	0.032774	0.020812	0.000152
	Oeiras	0.817498	0.177278	0.001804	0.00342	0
	Sintra	0.72606	0.166843	0.007043	0.099402	0.000651
	Vila Franca de Xira	0.648409	0.140564	0.006711	0.204242	7.46E-05
	Amadora	0.660453	0.166505	0.004926	0.16757	0.000546
	Odivelas	0.582056	0.227374	0.183789	0.006637	0.000144
	Alcochete	0.756375	0.203775	0.001766	0.00276	0.035324
	Almada	0.599762	0.237416	0.045395	0.09463	0.022797
	Barreiro	0.528791	0.22201	0.013315	0.03345	0.202434
	Moita	0.612047	0.231112	0.007676	0.054597	0.094568
	Montijo	0.757709	0.167179	0.002226	0.006516	0.06637
	Palmela	0.757164	0.151169	0.001481	0.086419	0.003767
	Seixal	0.602862	0.174951	0.016502	0.180737	0.024948
	Sesimbra	0.74288	0.137864	0.001618	0.113188	0.00445
	Setúbal	0.738678	0.205388	0.000791	0.051581	0.003561

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Energy consumption

km	Local residência/ Modo	Automóvel	Autocarro	Metro	Comboio	Barco
	Cascais	1024871.747	318590.07	97351.25	145776	632.8827
	Lisboa	7370238.606	1081336.9	41919.99	1262659	1445.517
	Loures	1130126.348	482086.6	275585.8	37873.51	1725.764
	Mafra	247032.9601	125687.37	12909.42	8197.409	59.8351
	Oeiras	718007.072	155702.96	1584.187	3003.783	0
	Sintra	2776411.999	637998.94	26933.32	380106	2490.699
	Vila Franca de Xira	988582.0039	214307.67	10231.13	311393.4	113.7635
	Amadora	955028.697	240769.84	7123.251	242308.9	789.2799
	Odivelas	505897.0623	197623.49	159740.8	5768.703	124.9129
	Alcochete	58505.59664	15762.016	136.6155	213.4618	2732.31
	Almada	735694.1653	291224.62	55684.01	116076.7	27963.52
	Barreiro	525740.9741	220729.38	13238.5	33256.99	201266.2
	Moita	345432.9861	130437.49	4332.305	30814	53373.21
	Montijo	202829.7217	44751.887	595.8252	1744.143	17766.42
	Palmela	411773.0496	82211.025	805.4754	46997.74	2048.709
	Seixal	808022.0944	234488.95	22117.45	242244.4	33438.08
	Sesimbra	258716.9647	48012.819	563.5307	39418.98	1549.71
	Setúbal	704187.3512	195798.1	754.3885	49172.41	3394.748

Total pkm = 28 524 168

Sustainable transportation system

wbcsd mobility

Global Environment (9 indicators)

Energy efficiency

Activity per vehicle - km

Share fuel k per vehicle(%)

Energy intensity fuel k vehicle j (MJ/L)

Final energy consumed per fuel – L/km

$$E = \frac{\left(\sum_{ij} A_{ij} \left(\sum_{k} S_{jk} * I_{jk} * EC_{k}\right)\right)}{TV_{pass} + (TV_{} * 8)}$$

Total - passenger x km

Total - freight ton x km

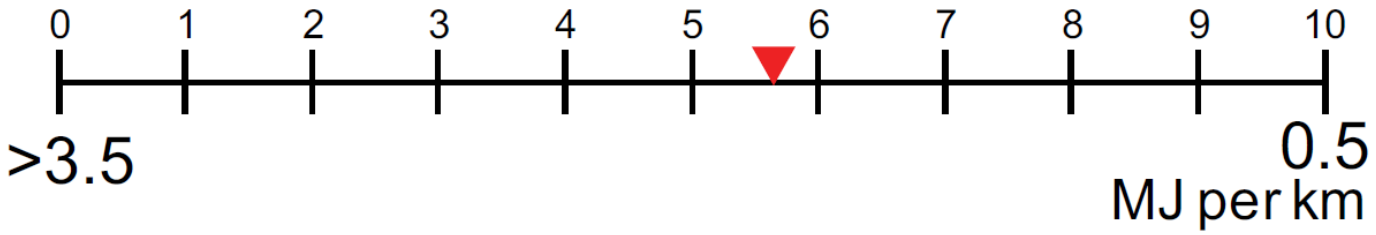
12.7tonnes/truck
1.5 persons/car

Sustainable transportation system

wbcsd mobility

Global Environment (9 indicators)

Energy efficiency



➔ 0: ≥3.5 [Mjoule/transport unit km]

➔10: ≤0.5 [Mjoule/transport unit km]

E – MJ/pkm (final energy)

Sustainable transportation system

Huss, A, Weingerl, P. JEC Tank-To-Wheels report v5: Passenger cars. Maas, H., Herudek, C., Wind, J., Hollweck, B., De Prada, L., Deix, S., Lahaussois, D., Faucon, R., Heurtaux, F., Perrier, B., Vidal, F, Gomes Marques, G., Prussi, M., Lonza, L., Yugo, M. and Hamje, H., editors. EUR 30270 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-19927-4, doi:10.2760/557004, JRC117560.

Sustainable transportation system

Table 5-6: Simulation Results for "ICE only" variants 2015

Simulation Resuts: 2015 Conventional ("ICE only") Variants **NEDC**	Curb Mass	Fuel Tank Capacity	Fuel Consumption		Energy Consumption			GHG emissions			
					Fuel	Electric	Total	as CO_2	as CH_4	as N_2O	TOTAL
	kg	L (kg)	l/100km	kg/100km	MJ/100km	MJ/100km	MJ/100km	gCO_2/km	gCO_2eq/km	gCO_2eq/km	gCO_2eq/km
DISI ("ICE only") 2015											
Gasoline E5	1310	55	5,49	4,10	173,33	#	173,33	127,17	0,13	0,54	127,83
Gasoline E10 market blend	1310	55	5,58	4,18	173,33	#	173,33	126,71	0,13	0,54	127,37
Gasoline high Octane spec. #1	1310	55	5,28	4,01	170,08	#	170,08	124,64	0,13	0,54	125,30
Gasoline high Octane spec. #2	1310	55	5,34	4,05	168,68	#	168,68	123,76	0,13	0,54	124,42
LPG	1352	80	6,99	3,84	176,77	#	176,77	116,02	0,13	0,54	116,69
CNG	1451	26 kg	#	3,67	176,02	#	176,02	98,76	1,50	0,54	100,79
E100	1310	55	8,14	6,46	173,16	#	173,16	123,58	0,13	0,54	124,24
DICI ("ICE only") 2015											
Diesel B0	1370	55	4,06	3,38	145,49	#	145,49	106,50	0,23	1,19	107,91
Diesel B7 market blend	1370	55	4,08	3,41	145,49	#	145,49	106,62	0,23	1,19	108,04
FAME	1370	55	4,39	3,91	145,49	#	145,49	110,78	0,23	1,19	112,19
DME	1418	80	7,81	5,24	148,70	#	148,70	100,14	0,23	1,19	101,56
FT-Diesel	1370	55	4,24	3,31	145,49	#	145,49	102,98	0,23	1,19	104,40
HVO	1370	55	4,24	3,31	145,49	#	145,49	102,98	0,23	1,19	104,40

Sustainable transportation system

Table 5-7: Simulation Results for Hybrid variants 2015

Simulation Resuts: 2015 Hybrid Variants **NEDC**	Curb Mass	Fuel Tank Capacity	Fuel Consumption		Energy Consumption			GHG emissions			
					Fuel	Electric	Total	as CO_2	as CH_4	as N_2O	TOTAL
	kg	L (kg)	l/100km	kg/100km	MJ/100km	MJ/100km	MJ/100km	gCO_2/km	gCO_2eq/km	gCO_2eq/km	gCO_2eq/km
Hybrid DISI 2015											
Gasoline E5	1421	55	4,05	3,02	127,83	#	127,83	93,79	0,13	0,54	94,45
Gasoline E10 market blend	1421	55	4,12	3,08	127,83	#	127,83	93,45	0,13	0,54	94,11
Gasoline high Octane spec. #1	1421	55	3,97	3,01	127,83	#	127,83	93,68	0,13	0,54	94,34
Gasoline high Octane spec. #2	1421	55	4,05	3,07	127,83	#	127,83	93,79	0,13	0,54	94,45
LPG	#	#	#	#	#	#	#	#	#	#	#
CNG	#	#	#	#	#	#	#	#	#	#	#
E100	1421	55	6,01	4,77	127,83	#	127,83	91,23	0,13	0,54	91,89
Hybrid DICI 2015											
Diesel B0	1481	55	3,22	2,68	115,47	#	115,47	84,52	0,23	1,19	85,94
Diesel B7 market blend	1481	55	3,23	2,70	115,47	#	115,47	84,62	0,23	1,19	86,03
FAME	1481	55	3,49	3,10	115,47	#	115,47	87,92	0,23	1,19	89,33
DME	1529	40	6,17	4,13	117,32	#	117,32	79,02	0,23	1,19	80,43
FT-Diesel	1481	55	3,36	2,62	115,47	#	115,47	81,73	0,23	1,19	83,15
HVO	1481	55	3,36	2,62	115,47	#	115,47	81,73	0,23	1,19	83,15

Sustainable transportation system

Table 5-8: Simulation Results for PHEV variants 2015; note that Electric Energy Consumption includes charging losses

Simulation Resuts: 2015 PHEV Variants **NEDC**	Curb Mass	Fuel Tank Capacity	Fuel Consumption		Energy Consumption			GHG emissions			
					Fuel	Electric	Total	as CO_2	as CH_4	as N_2O	TOTAL
	kg	L (kg)	l/100km	kg/100km	MJ/100km	MJ/100km	MJ/100km	gCO_2/km	gCO_2eq/km	gCO_2eq/km	gCO_2eq/km
PHEV50 SI 2015											
Gasoline E5	1500	55	1,38	1,03	43,52	37,21	80,73	31,93	0,04	0,18	32,15
Gasoline E10 market blend	1500	55	1,40	1,05	43,52	37,21	80,73	31,82	0,04	0,18	32,04
Gasoline high Octane spec. #1	1500	55	1,35	1,03	43,52	37,21	80,73	31,90	0,04	0,18	32,11
Gasoline high Octane spec. #2	1500	55	1,38	1,05	43,52	37,21	80,73	31,93	0,04	0,18	32,15
LPG	#	#	#	#	#	#	#	#	#	#	#
CNG	#	#	#	#	#	#	#	#	#	#	#
E100	1500	55	2,05	1,62	43,52	37,21	80,73	31,06	0,04	0,18	31,28
PHEV50 CI 2015											
Diesel B0	1560	55	1,25	1,04	44,69	35,16	79,85	32,71	0,09	0,45	33,25
Diesel B7 market blend	1560	55	1,25	1,05	44,69	35,16	79,85	32,75	0,09	0,45	33,29
FAME	1560	55	1,35	1,20	44,69	35,16	79,85	34,03	0,09	0,45	34,56
DME	1608	80	2,39	1,60	45,46	35,16	80,63	30,62	0,09	0,45	31,16
FT-Diesel	1560	55	1,30	1,02	44,69	35,16	79,85	31,63	0,09	0,45	32,17
HVO	1560	55	1,30	1,02	44,69	35,16	79,85	31,63	0,09	0,45	32,17

Sustainable transportation system

Table 5-9: Simulation Results for REEV variants 2015; note that Electric Energy Consumption includes charging losses

Simulation Resuts: 2015 REEV Variants **NEDC**	Curb Mass	Fuel Tank Capacity	Fuel Consumption		Energy Consumption			GHG emissions			
					Fuel	Electric	Total	as CO_2	as CH_4	as N_2O	TOTAL
	kg	L (kg)	l/100km	kg/100km	MJ/100km	MJ/100km	MJ/100km	gCO_2/km	gCO_2eq/km	gCO_2eq/km	gCO_2eq/km
REEV100 SI 2015											
Gasoline E5	1526	55	0,86	0,64	27,18	40,02	67,20	19,94	0,03	0,12	20,09
Gasoline E10 market blend	1526	55	0,88	0,66	27,18	40,02	67,20	19,87	0,03	0,12	20,01
Gasoline high Octane spec. #1	1526	55	0,84	0,64	27,18	40,02	67,20	19,92	0,03	0,12	20,06
Gasoline high Octane spec. #2	1526	55	0,86	0,65	27,18	40,02	67,20	19,94	0,03	0,12	20,09
LPG	#	#	#	#	#	#	#	#	#	#	#
CNG	#	#	#	#	#	#	#	#	#	#	#
E100	1526	55	1,28	1,01	27,18	40,02	67,20	19,40	0,03	0,12	19,54

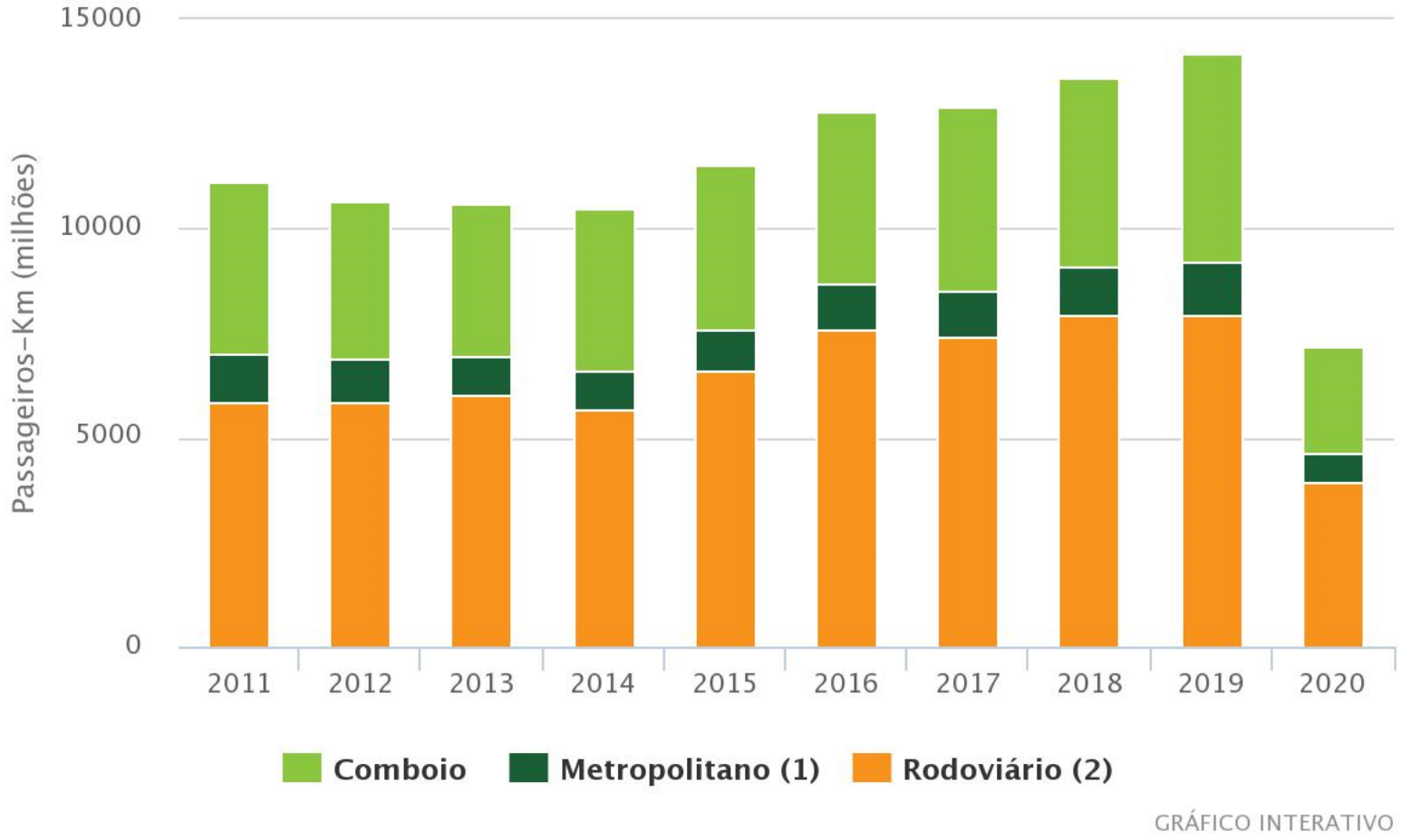
5.2.2.4 BEV

Table 5-10: Simulation Results for BEV 2015; note that Electric Energy Consumption includes charging losses

Simulation Resuts: 2015 BEV Variants **NEDC**	Curb Mass	Fuel Tank Capacity	Fuel Consumption		Energy Consumption			GHG emissions			
					Fuel	Electric	Total	as CO_2	as CH_4	as N_2O	TOTAL
	kg	L (kg)	l/100km	kg/100km	MJ/100km	MJ/100km	MJ/100km	gCO_2/km	gCO_2eq/km	gCO_2eq/km	gCO_2eq/km
BEV150 2015											
Electricity	1326	#	#	#	#	45,66	45,66	0,00	0,00	0,00	0,00

Sustainable transportation system

https://rea.apambiente.pt/content/transporte-de-passageiros



Sustainable transportation system

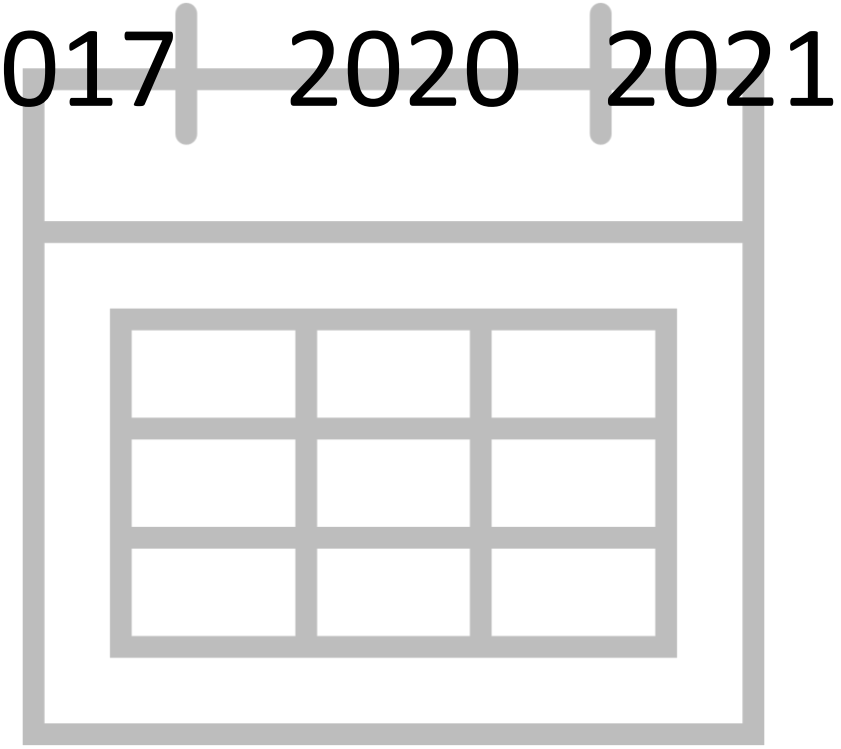
https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Passenger_mobility_statistics#Mobility_data_for_thirteen_Member_States_with_different_characteristics

https://www.imt-ip.pt/sites/IMTT/Portugues/Noticias/Paginas/AnuarioEstatisticoMobilidadeTransportes2021.aspx

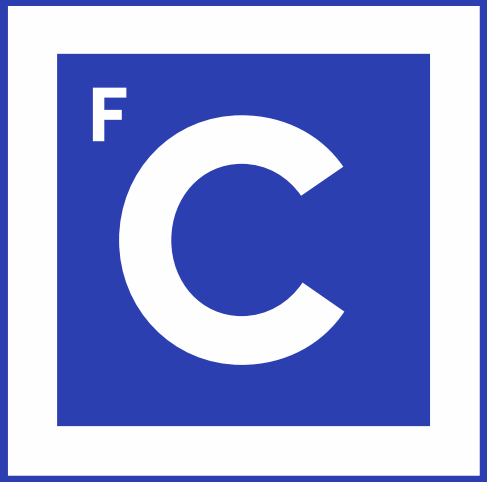
Assignment Module #2

Excel calculation of ENERGY EFFIENCY for Lisbon AML and at least 1 other region outside Portugal for the same year. Justify all assumptions.

Deadline: 26 April
Deliver excel by e-mail: camsilva@fc.ul.pt



Thanks



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